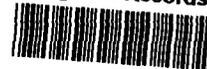


EPA Contract No. 68-W8-0093
Work Assignment No. 17-5L4J
Donohue Project No. 20026.001

00010
EPA Region 5 Records Ctr.



200032

VOLUME 2
FIELD SAMPLING PLAN
HIMCO DUMP
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
ELKHART, INDIANA
FINAL
JULY 1990

Prepared for:

U.S. Environmental Protection Agency
Emergency and Remedial Response Branch
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TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
1.0	SITE BACKGROUND AND HISTORY	1-1
2.0	FIELD INVESTIGATION OBJECTIVES AND APPROACH	2-1
3.0	FIELD TEAM ORGANIZATION AND RESPONSIBILITIES	3-1
3.1	Field Team Leader	3-1
3.2	Field Team	3-1
3.3	Site Quality Control Officer	3-2
3.4	Field Data Coordinator	3-2
3.5	Site Health and Safety Officer	3-2
3.6	Assistant Health and Safety Officer	3-3
4.0	MEDIA-SPECIFIC SAMPLING PLANS	4-1
4.1	Soil Sampling Plan	4-1
4.1.1	Introduction	4-1
4.1.2	Equipment	4-1
4.1.3	Soil Sampling Procedures	4-12
4.1.3.1	Soil Sampling of Existing Landfill Cover...	4-12
4.1.3.2	Geotechnical Sampling from Beneath Landfill Cover	4-12
4.1.4	Decontamination	4-13
4.1.5	Quality Control	4-13
4.1.6	Documentation	4-14
4.2	Groundwater Sampling Plan	4-14
4.2.1	Soil Boring and Geotechnical Sampling	4-14
4.2.1.1	Introduction	4-14
4.2.1.2	Equipment	4-18
4.2.1.3	Drilling and Sampling Procedures	4-18
4.2.1.4	Decontamination	4-19
4.2.1.5	Quality Control	4-19
4.2.1.6	Documentation	4-19
4.2.2	Monitoring Well Installation	4-20
4.2.2.1	Introduction	4-20
4.2.2.2	Equipment	4-20
4.2.2.3	Well Installation Procedures	4-21
4.2.2.4	Decontamination	4-22
4.2.2.5	Quality Control	4-22
4.2.2.6	Documentation	4-23
4.2.3	Hydraulic Characterization	4-23
4.2.3.1	Introduction	4-23
4.2.3.2	Equipment	4-23
4.2.3.3	Procedures	4-23
4.2.3.4	Decontamination	4-25
4.2.3.5	Quality Control	4-25
4.2.3.6	Documentation	4-26

<u>Section</u>	<u>Page</u>
4.2.4 Groundwater Sampling	4-26
4.2.4.1 Introduction	4-26
4.2.4.2 Equipment	4-26
4.2.4.3 Groundwater Sample Collection Procedures ..	4-28
4.2.4.4 Decontamination	4-29
4.2.4.5 Quality Control	4-25
4.2.4.6 Documentation	4-30
4.2.5 Cone Penetrometer Test	4-30
4.2.5.1 Introduction	4-30
4.2.5.2 Equipment	4-30
4.2.5.3 Procedures	4-31
4.2.5.4 Decontamination	4-31
4.2.5.5 Quality Control	4-31
4.2.5.6 Documentation	4-31
4.3 Surface Water Hydraulic Monitoring	4-31
4.3.1 Introduction	4-31
4.3.2 Equipment	4-32
4.3.3 Staff Gauge Monitoring Procedures	4-32
4.3.4 Decontamination	4-32
4.3.5 Quality Control	4-32
4.3.6 Documentation	4-32
4.4 Waste Mass Gas Sampling	4-33
4.4.1 Introduction	4-33
4.4.2 Equipment	4-33
4.4.3 Sample Collection Procedures	4-35
4.4.4 Decontamination	4-37
4.4.5 Quality Control	4-37
4.4.6 Documentation	4-37
4.5 Geophysical Investigation - Electromagnetic and Magnetometer Surveys	4-37
4.5.1 Introduction	4-37
4.5.2 Instrumentation and Equipment	4-38
4.5.3 Data Collection Procedures	4-39
4.5.4 Decontamination	4-39
4.5.5 Quality Control	4-39
4.5.6 Documentation	4-40
4.6 Wetlands Assessment and Delineation	4-40
4.6.1 Introduction	4-40
4.6.2 Equipment	4-40
4.6.3 Wetlands Delineation Procedures	4-41
4.6.4 Wetlands Soil Sampling Procedures	4-42
4.6.5 Decontamination	4-42
4.6.6 Quality Control	4-42
4.6.7 Documentation	4-42
4.7 Surface Water and Sediment Sampling	4-43
4.7.1 Introduction	4-43
4.7.2 Equipment	4-43
4.7.3 Sampling Procedures	4-43
4.7.3.1 Surface Water	4-43
4.7.3.2 Sediment	4-43

<u>Section</u>	<u>Page</u>
4.7.4 Decontamination	4-44
4.7.5 Quality Control	4-44
4.7.6 Documentation	4-44
4.8 Residential Gas Sampling	4-44
4.8.1 Introduction	4-44
4.8.2 Equipment	4-45
4.8.3 Procedures	4-45
4.8.4 Decontamination	4-45
4.8.5 Quality Control	4-45
4.8.6 Documentation	4-45
4.9 Test Pits	4-46
4.9.1 Introduction	4-46
4.9.2 Equipment	4-46
4.9.3 Procedures	4-46
4.9.4 Decontamination	4-46
4.9.5 Quality Control	4-47
4.9.6 Documentation	4-47
4.10 Leachate Seeps	4-47
4.10.1 Introduction	4-47
4.10.2 Equipment	4-47
4.10.3 Procedures	4-48
4.10.4 Decontamination	4-48
4.10.5 Quality Control	4-48
4.10.6 Documentation	4-48
5.0 SAMPLE IDENTIFICATION NUMBERS AND DOCUMENTATION.....	5-1
5.1 Field Sample Identification Number	5-1
5.2 Sample Location Identifier.....	5-1
5.3 Sample Labels.....	5-2
5.4 Sample Tags.....	5-3
5.5 Central Regional Laboratory Sample Number	5-3
6.0 CHAIN OF CUSTODY	6-1
7.0 PACKAGING AND SHIPPING	7-1
7.1 Packaging Requirements	7-1
7.2 Shipment Coordination	7-2

LIST OF FIGURES

<u>Figure</u>		<u>Follows Page</u>
4-1	Approximate Site Sampling Locations.....	4-12
4-2	Boring, Monitoring Well, and Existing USGS Well Locations.....	4-26
4-3	Wetlands Sampling Areas	4-40

LIST OF TABLES

<u>Table</u>		<u>Page</u>
4-1	Sampling and Analysis Summary Table for Himco Dump.....	4-2
4-2	Sample Volumes, Containers, and Preservation Techniques	4-9
4-3	Soil Sampling Plan Rationale	4-11
4-4	Groundwater Sampling Plan Rationale	4-15
4-5	Borings and Monitoring Well Designations	4-17
4-6	In-Field Hydraulic Conductivity Testing	4-24
4-7	USGS Wells Used in the Sampling Event	4-27
4-8	Waste Mass Gas Sampling Designations	4-34

LIST OF APPENDICES

A	Field Documentation Forms
B	Schematic Diagrams
C	Calibration and Operating Procedures for Field Instruments and Filtration Unit
D	Field Meter Calibration Procedures
E	Standard Operating Procedures for Field Measurements
F	Determination of Number of Samples of CAP Soil for Chemical Analysis
G	Determination of Number of Samples of Monitoring Well Borings for Chemical Analysis

ACRONYMS

Himco Dump FSP
Elkhart, Indiana

ABN	Acid and Base-Neutral Semivolatile Organic Compounds
ASTM	American Society of Testing Materials
BNA	Base-Neutral and Acid Semivolatile Organic Compounds (same as ABN)
BOD	Biochemical Oxygen Demand
CDO	Central District Office, U.S. EPA Region V
CH ₄	Methane
Cl	Chloride
CLP	Contract Laboratory Program
CN	Cyanide
COD	Chemical Oxygen Demand
COE	Corps of Engineers, U.S. Army
CRDL	Contract Required Detection Limit
CRL	Central Regional Laboratory, U.S. EPA Region V
CRQL	Contract Required Quantitation Limit
DO	Dissolved Oxygen
DQO	Data Quality Objective
E&E	Ecology & Environment, Inc.
EM	Electromagnetic Meter
EMSL	Environmental Monitoring and Support Laboratory, U.S. EPA
EPA	U.S. Environmental Protection Agency
FIT	Field Investigation Team
FS	Feasibility Study
FSP	Field Sampling Plan
FTL	Field Team Leader, Donohue
GC/MS	Gas Chromatography/Mass Spectrometry
GFAA	Graphite Furnace Atomic Absorption
HNO ₃	Nitric Acid
HNu	Photoionization detector manufacturer
HQ	Headquarters, U.S. EPA
H ₂ S	Hydrogen Sulfide
IADS	Inorganic Analysis Data Sheet
ICP	Inductively Coupled Argon Plasma Spectrometer
I.D.	Inner Diameter
IDEM	Indiana Department of Environmental Management
IDL	Instrument Detection Limit
ISBH	Indiana State Board of Health
LSSS	Laboratory Support Services Section, U.S. EPA Region V
Lumidor	Gas monitoring device manufacturer
MCL	Maximum Contaminant Level
NC	Not Calculated
NEIC	National Enforcement Investigations Center, U.S. EPA
NH ₃	Ammonia Nitrogen
NO ₂ +NO ₃	Nitrite + Nitrate Nitrogen
NPL	National Priorities List

ACRONYMS

Himco Dump FSP
Elkhart, Indiana

OADS	Organic Analysis Data Sheet
OERR	Office of Emergency and Remedial Response, U.S. EPA
PCBs	Polychlorinated Biphenyls
PCB/P	PCBs and Pesticides
pH	Measure of acidity indicated as log of hydrogen ion concentration
PM	Project Manager, Donohue
PRP	Potentially Responsible Party
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAMS	Quality Assurance Management Staff, U.S. EPA
QAPP	Quality Assurance Project Plan
QC	Quality Control
%R	Percent Recovery
RAS	Routine Analytical Services
RI	Remedial Investigation
RMCL	Recommended Maximum Contaminant Level
RPD	Relative Percent Difference
RPM	Remedial Project Manager, U.S. EPA
RPO	Remedial Project Officer, U.S. EPA
RSCC	Regional Sample Control Center, U.S. EPA
SAS	Special Analytical Services
SM	Site Manager, Donohue
SMO	Sample Management Office
SO ₄	Sulfate
SOP	Standard Operating Procedure
SOW	Statement of Work
SQCO	Site Quality Control Officer, Donohue
TAC	Technical Advisory Committee, Donohue
TAL	Target Analyte List
TCL	Target Compound List
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorus
TSQAM	Technical Services Quality Assurance Manager, Donohue
TSS	Total Suspended Solids
USGS	United States Geological Survey
VOA	Volatile Organic Compounds
VOC	Volatile Organic Compounds (same as VOA)

1.0 SITE BACKGROUND AND HISTORY

Full discussions of the background and history of the Himco Dump Superfund Site are provided in the Himco Dump Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Volume 1A).

2.0 FIELD INVESTIGATION OBJECTIVES AND APPROACH

The purpose of the Himco Dump RI/FS field investigation activities described in this Field Sampling Plan (FSP) is to satisfy data needs associated with the following objectives:

1. Characterize the nature and extent of contamination in site soils, sediment, landfill gas, surface water, wetlands and groundwater.
2. Determine the potential for contaminant transport via air, groundwater and sediment/surface with pathways.
3. Provide data needed to evaluate human health risk associated with the site.
4. Provide data necessary to assess the feasibility and cost-effectiveness of remedial action alternatives.

The following chapters describe the approach and standard operating procedures to be used for: field team organization and responsibilities; media-specific sampling including sample location and rationale, equipment required, sampling procedures, decontamination, quality control, and documentation; and sample identification numbers, chain of custody, and packaging and shipping. A detailed discussion of the RI field investigation rationale and approach is presented in Section 4 of the Work Plan.

3.0 FIELD TEAM ORGANIZATION AND RESPONSIBILITIES

Donohue & Associates, Inc. (Donohue) and pool subcontractors will perform field sampling activities under the direction of the Field Team Leader. Field team members and their responsibilities follow.

3.1 FIELD TEAM LEADER

The Field Team Leader (FTL) will have overall responsibility for completion of all field activities according to the FSP. The FTL is the overall coordinator of activities at the site and is the communication link between field team members, the Site Quality Control Officer, the Field Data Coordinator, and the Site Manager. The FTL will assign specific field duties to team members in conjunction with the Site Manager and FTL will be on-site during all field activities and oversee operations. The FTL will be responsible for mobilization and demobilization of the field team and subcontractors and will direct the activities of all subcontractors on-site. Any logistical problems hindering field activities, such as equipment malfunctions or availability, personnel conflicts, or weather dependent working conditions, will be relayed to, and resolved by the FTL.

Field team members will report directly to the FTL and provide daily verbal progress reports of field activities. The FTL is responsible for completing the site Daily Log Book. The FTL is responsible for informing the Site Manager of daily activities. The FTL is responsible for supplying field team members with appropriate field notebooks and field documentation forms.

3.2 FIELD TEAM

Field team members will collect soil, sediment and surface water samples; perform waste mass gas sampling; perform a wetlands assessment and delineation; install, develop, test, and sample wells; conduct residential well and gas sampling; perform a geophysical survey over the landfilled areas; install and monitor staff gauges. Decontamination of sampling equipment will be accomplished by the field team under the direction of the FTL. Field team members will complete and file personal daily time logs and complete field documentation forms as indicated in the FSP. Field team members will submit field documentation forms to the Site Quality Control Officer and will relinquish custody of field samples to the Field Data Coordinator. Field team members may assist in sample packaging and shipping. All field team members will comply with the provisions of the Site-Specific Health and Safety Plan (HASp).

3.3 SITE QUALITY CONTROL OFFICER

The Site Quality Control Officer (SQCO) will check the completion of chain-of-custody forms, packaging and shipment of samples, sample log book entries, and EPA sample traffic control paperwork for accuracy and compliance with EPA Contract Laboratory Program (CLP) protocols. The SQCO will check the daily time logs and field data forms for accuracy and compliance with the QAPP and FSP. The SQCO is responsible for maintaining field instrument calibration logs for field instruments. After review of documentation, the SQCO is responsible for storing and forwarding the documentation for filing in accordance with appropriate document control and security measures. The SQCO may be a member of the field team but cannot be the Field Data Coordinator.

3.4 FIELD DATA COORDINATOR

The Field Data Coordinator (FDC) will be responsible for maintaining an adequate supply of sample containers, preservatives, labels, and shipping materials in the field. The FDC will complete, sign, and date chain-of-custody and EPA sample traffic control forms, and ensure that custody seals are on shipping containers and that samples are shipped promptly. The FDC will assign site-specific sample numbers and Central Regional Laboratory (CRL) sample numbers as described in Section 5.0. The FDC will receive samples from the field team and package them for shipment according to the procedures specified in Section 7.0. The FDC will be the contact to the EPA Sample Management Office (SMO), Region V Regional Sample Control Center (RSCC), and laboratories regarding the shipment and arrival of samples. The FDC will maintain sample collection, labeling, and shipment documentation in the sample log book. The sample log book will follow the format shown in Appendix A. The FDC may also be a member of the field team but cannot be the SQCO.

3.5 SITE HEALTH AND SAFETY OFFICER

The Health and Safety Officer (HSO) will be present on-site during all Level A, B, or C field operations and will be responsible for all health and safety activities and delegation of duties to the health and safety staff in the field. Because the Himco Dump site is identified as low-hazard Level C or Level D, the HSO may direct site health and safety efforts through an Assistant HSO approved by the Company Health and Safety Supervisor (CHSS). The Assistant HSO will be responsible for implementing the HASP. The HSO may direct or participate in downrange activities as appropriate when this does not interfere with primary HSO responsibility. The HSO has stop-work authorization which can be executed upon his/her determination of an imminent safety hazard, emergency condition, or other potentially dangerous situations, such as detrimental weather conditions. Authorization to proceed with work will be issued by the CHSS in conjunction with the Site Manager after such action. The HSO will initiate and execute all contact with support facilities and personnel when this action is appropriate.

3.6 ASSISTANT HEALTH AND SAFETY OFFICER

On low-hazard Level C or Level D sites, the Assistant HSO may have collateral duties but must be qualified for the health and safety responsibility by the CHSS. At Level A, B, or specific Level C sites, he/she will be the downrange person who accompanies field sampling teams and will report to the HSO. Additionally, he/she will be required to support the HSO when multiple operations are conducted that require monitoring and HSO surveillance. The Assistant HSO's primary responsibility is to provide appropriate monitoring to ensure the safe conduct of field operations. He/she will have access to continuous communications with the command post. The number of Assistant HSOs will depend upon the number of downrange operations occurring simultaneously, designated levels of protection, and individual assignments made by the HSO. The Assistant HSO will also share responsibility with the FTL and the HSO for ensuring that all safety practices are followed by downrange teams.

4.0 MEDIA-SPECIFIC SAMPLING PLANS

A summary of sampling and analysis to be performed for all media is shown on Table 4-1. Sample volumes, container, and preservatives required are shown on Table 4-2.

4.1 SOIL SAMPLING PLAN

4.1.1 Introduction

The nature of historical waste disposal practices at the Himco Dump site necessitates collection of surficial soil samples. Surface samples will be collected from an approximate 6- to 18-inch depth from the existing landfill cover for chemical analysis. Additional samples at a depth of 0 to 3 feet will be obtained from beneath the existing topsoil cover to determine the geotechnical properties of the waste.

Soil sampling locations will be assigned using a stratified systematic design. This approach is based on principles described in "Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media" (EPA 230102-89-042, 1989). This design is appropriate both for the soil heterogeneity expected based on site history and contaminant sources, and for identification of contaminant "hot spots." Approximate soil sampling locations are shown in Figure 4-1. Actual sampling locations will be dependent on field observations and conditions encountered on-site. The rationale for selecting these sampling locations is included on Table 4-3.

Each soil sample will be analyzed for the Target Analyte List (TAL) metals/cyanide, and the Target Compound List (TCL) VOC, BNA, and PCB/pesticides.

4.1.2 Equipment

The following equipment and materials will be used during soil sampling:

1. A drill rig capable of pushing a 3-inch diameter, 3-foot long Shelby tube into the soil with a continuous motion without impact or twisting.
2. Stainless steel shovel.
3. Water, deionized and tap.
4. Isopropanol (A.C.S.).
5. Five-gallon pail with cover to contain isopropanol rinses.
6. Liquinox soap.
7. Brushes.
8. Stainless steel bowls and spoons.
9. Containers and preservatives as indicated on Table 4-2.
10. EPA Region V sample tags and SMO traffic report labels.
11. Munsell Soil Color Chart.
12. Stainless steel hand trowel.
13. Plastic bags.

TABLE 4-1

Sampling and Analysis Summary Table for Himco Dump Phase I

Sample Matrix	Field Parameters	DQO Level	Lab Parameters	DQO Level	Lab	Field Samples	Field QC					Total to Lab	Lab QC			Purpose of Samples
							BB ³	BG	TB**	FB	FD		LD	MSD*	MS	
SITE CONDITIONS	EM-31 Conductivity	1					-	-	-	-	-					Determine limits of fill Assess if buried drums present
LANDFILL CAP AND WASTE			Geotech Consolidation ¹	V	CLP SAS	2 Max	-	-	-	-	-	2 Max	-	-	-	Use to predict amount and rate of settlement under loads for remedial alternatives Determine strength of waste for remedial alternatives Determine material properties of waste mass
			Triaxial Shear ¹	V		5 Max	-	-	-	-	5 Max	-	-	-		
			Grain Size ²	V		5 Max	-	-	-	-	5 Max	-	-	-		
			Atterberg Limits ²	V		5 Max	-	-	-	-	5 Max	-	-	-		
		6-18"	TCL VOA	IV	CLP	30	-	-	-	-	3	33	-	2	2	Risk assessment - dust particulate emission releases Evaluate remedial alternatives
			TCL BNA	IV		30	-	-	-	-	3	33	-	2	2	
			TCL PCB/P	IV		30	-	-	-	-	3	33	-	2	2	
			TAL Metals/CN	IV		30	-	-	-	-	3	33	2	-	2	
LANDFILL WASTE MASS GAS	Volume	1	TCL VOA (Sorbent tubes)	V	CLP SAS	10 Max	14	15	1	-	1	13 Max	-	1	1	Waste characterization. Risk assessment of volatile emission release mechanism Evaluate remedial alternatives
	Methane	1		CLP SAS Quick Turn		2	-	-	1	-	-	2	-	1	1	
	Hydrogen Sulfide	1														
	VOCs by HNU	1														

NOTES:

- ¹Thin-walled Shelby tube
- ²Ziploc bag
- ³Assume bottle cleaning protocol submitted with QAPP acceptable
- ⁴Unexposed sorbent tube
- ⁵Offsite location

* MS/MSD samples required for organic analysis. Aqueous samples (groundwater, surface water, leachate, private well water) shall be collected, with extra sample volume at a frequency of one per 20 or fewer investigative samples. Triple the normal volume will be collected for VOAs and double the normal volume will be collected for BNA and PCB/P.

** Trip blanks will be shipped at a frequency of one per cooler of aqueous/sorbent tubes containing aqueous/sorbent tube samples for VOA analysis.

Legend

- BB = Bottle Blank
- BG = Background Blank
- TB = Trip Blank
- FB = Field Blank
- FD = Field Duplicate
- LD = Lab Duplicate
- MSD = Matrix Spike Duplicate
- MS = Matrix Spike
- = Not Applicable
- UG = Upgradient

TABLE 4-1

Sampling and Analysis Summary Table for Himco Dump Phase I

Sample Matrix	Field Parameters	DQO Level	Lab Parameters	DQO Level	Lab	Field Samples	Field QC					Total to Lab	Lab QC			Purpose of Samples
							BB ¹	BG	TB**	FB	FD		LD	MSD*	MS	
LEACHATE (if available)	pH	1	TCL VOA	IV	CLP	4 Max	-	-	1	1	1	6	-	1	1	Waste characterization of primary source Risk assessment Evaluate remedial alternatives
	Conductivity	1	TCL BNA	IV	CLP	4 Max	-	-	-	1	1	6	-	1	1	
	DO	1	TCL PCB/P	IV	CLP	4 Max	-	-	-	1	1	6	-	1	1	
	Temperature	1	TAL Metals/CN (Total) ³	IV	CLP	4 Max	-	-	-	1	1	6	1	-	1	
			Water Quality ⁴	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			COD	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			Cl	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			SO ₄	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			NH ₃	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			NO ₂ +NO ₃	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			TKN	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			TP	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			TDS	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			TSS	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	
			alkalinity bromide, dissolved	V	CLP SAS	4 Max	-	-	-	1	1	6	1	-	1	

NOTES:

¹Assume bottle cleaning protocol submitted with QAPP acceptable.

²Assume able to access 6 abandoned shallow wells.

³Total metals are defined as digestion and analysis of TAL metals on an unfiltered sample. Dissolved metals are defined as digestion and analysis of TAL metals on a sample filtered in the field.

⁴Water quality analyses will be done on unfiltered sample except for bromide which will be field filtered.

*MS/MSD samples required for organic analysis. Aqueous samples (groundwater, surface water, leachate, private well water) shall be collected, with extra sample volume at a frequency of one per 20 or fewer investigative samples. Triple the normal volume will be collected for VOAs and double the normal volume will be collected for BNA and PCB/P.

** Trip blanks will be shipped at a frequency of one per cooler of aqueous/sorbent tubes containing aqueous/sorbent tube samples for VOA analysis.

Legend

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TABLE 4-1

Sampling and Analysis Summary Table for Himco Dump Phase I

Sample Matrix	Field Parameters	DQO Level	Lab Parameters	DQO Level	Lab	#Field Samples	Field QC					Total to Lab	Lab QC			Purpose of Samples
							BB ¹	BG	TB**	FB	FD		LD	MSD*	MS	
EXISTING USGS WELL WATER	Slug Test	I														Determine nature and extent of contamination Develop groundwater table map Evaluate remedial alternatives Risk assessment
	Water Level	I	TCL VOA	IV	CLP	18	-	5 UG	2	2	2	27	-	2	2	
	pH	I	TCL BNA	IV	CLP	18	-	5 UG	-	2	2	27	-	2	2	
	Conductivity	I	TCL PCB/P	IV	CLP	18	-	5 UG	-	2	2	27	-	2	2	
	DO	I	TAL Metals/CN (Total and Dissolved) ³	IV	CLP	18	-	5 UG	-	2	2	27	2	-	2	
	Temperature	I														
	Water Quality ⁴	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3	
	COD	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3	
	Cl	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3	
	SO ₄	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3	
	NH ₃	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3	
	NO ₂ +NO ₃	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3	
	TKN	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3	
	TP	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3	
	TDS	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	-	
	TSS	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	-	
alkalinity	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3		
bromide, dissolved	V	CLP SAS	V	CLP SAS	18	-	5 UG	-	2	2	27	3	-	3		

NOTES:

- ¹Assume bottle cleaning protocol submitted with QAPP acceptable.
- ²Assume able to access 6 abandoned shallow wells.
- ³Total metals are defined as digestion and analysis of TAL metals on an unfiltered sample. Dissolved metals are defined as digestion and analysis of TAL metals on a sample filtered in the field.
- ⁴Water quality analyses will be done on unfiltered sample except for bromide which will be field filtered.

Page 3 of 7

* MS/MSD samples required for organic analysis. Aqueous samples (groundwater, surface water, leachate, private well water) shall be collected, with extra sample volume at a frequency of one per 20 or fewer investigative samples. Triple the normal volume will be collected for VOAs and double the normal volume will be collected for BNA and PCB/P.

** Trip blanks will be shipped at a frequency of one per cooler of aqueous/sorbent tubes containing aqueous/sorbent tube samples for VOA analysis.

† Groundwater chemical samples will be taken quarterly. Four sets of the same number of samples given above will be taken.

Legend

- BB = Bottle Blank
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- MSD = Matrix Spike Duplicate
- MS = Matrix Spike
- = Not Applicable
- UG = Upgradient

TABLE 4-1
Sampling and Analysis Summary Table for Himco Dump
Phase I

Sample Matrix	Field Parameters	DQO Level	Lab Parameters	DQO Level	Lab	#Field Samples	Field QC					Total to Lab	Lab QC			Purpose of Samples
							BB ¹	BG	TB**	FB	FD		LD	MSD*	MS	
PRIVATE WELL WATER	pH	1	TCL VOA	V	CLP SAS	12 Max ²	-	-	1	2	2	16	-	1	1	Determine nature and extent of contamination Evaluate remedial alternatives Risk Assessment
	Conductivity	1	TCL BNA	V	CLP SAS	12 Max ²	-	-	-	2	2	16	-	1	1	
	DO	1	TCL PCB/P	V	CLP SAS	12 Max ²	-	-	-	2	2	16	-	1	1	
	Temperature	1	TAL Metals/CN (Total) ³	V	CLP SAS	12 Max ²	-	-	-	2	2	16	1	-	1	
			Water Quality ⁴	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	2	
			COD	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	2	
			Cl	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	2	
			SO ₄	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	2	
			NH ₃	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	2	
			NO ₂ +NO ₃	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	2	
			TKN	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	2	
			TP	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	2	
			TDS	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	-	
			TSS	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	-	
			alkalinity bromide, dissolved	V	CLP SAS	12 Max ²	-	-	-	2	2	16	2	-	2	

NOTES:

- ¹Assume bottle cleaning protocol submitted with QAPP acceptable.
 - ²Assume able to access 6 abandoned shallow wells.
 - ³Total metals are defined as digestion and analysis of TAL metals on an unfiltered sample. Dissolved metals are defined as digestion and analysis of TAL metals on a sample filtered in the field.
 - ⁴Water quality analyses will be done on unfiltered sample except for bromide which will be field filtered.
- Page 4 of 7

* MS/MSD samples required for organic analysis. Aqueous samples (groundwater, surface water, leachate, private well water) shall be collected, with extra sample volume at a frequency of one per 20 or fewer investigative samples. Triple the normal volume will be collected for VOAs and double the normal volume will be collected for BNA and PCB/P.

** Trip blanks will be shipped at a frequency of one per cooler of aqueous/sorbent tubes containing aqueous/sorbent tube samples for VOA analysis.

¹ Groundwater chemical samples will be taken quarterly. Four sets of the same number of samples given above will be taken.

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TABLE 4-1

Sampling and Analysis Summary Table for Himco Dump Phase I

Sample Matrix	Field Parameters	DQO Level	Lab Parameters	DQO Level	Lab	#Field Samples	Field QC					Total to Lab	Lab QC			Purpose of Samples		
							BB ¹	BG	TB**	FB	FD		LD	MSD*	MS			
SOIL FROM NEW WELL INSTALLATIONS	VOAs by DNU Radiactivity	I	TCL VOA	IV	CLP	30 Max	-	-	-	-	3	33	-	2	2	Determine subsurface geology and soil chemistry for evaluation of remedial alternatives Nature and extent of contamination		
		I	TCL BNA	IV	CLP	30 Max	-	-	-	-	3	33	-	2	2			
			TCL PCB/P	IV	CLP	30 Max	-	-	-	-	3	33	-	2	2			
			TAL Metals/CN	IV	CLP	30 Max	-	-	-	-	3	33	2	-	2			
			Geotech															
			TOC	V	CLP SAS	V	CLP SAS	20 Max	-	-	-	-	20					
			Atterberg	V	CLP SAS	V	CLP SAS	20 Max	-	-	-	-	20					
			Grain Size	V	CLP SAS	V	CLP SAS	20 Max	-	-	-	-	20					
	Permeability	V	CLP SAS	V	CLP SAS	3 Max	-	-	-	-	3							
NEW WELLS GROUNDWATER	Slug Test Water Level pH Conductivity DO Temperature	I	TCL VOA	IV	CLP	7	-	3 UG	1	1	1	12	-	1	1	Determine if USGS wells suitable for chemistry Nature and extent of contamination Risk assessment		
		I	TCL BNA	IV	CLP	7	-	3 UG	-	1	1	12	-	1	1			
		I	TCL PCB/P	IV	CLP	7	-	3 UG	-	1	1	12	-	1	1			
		I	TAL Metals/CN (Total and Dissolved) ²	IV	CLP	7	-	3 UG	-	1	1	12	1	-	1			
			Water Quality ³	V	CLP SAS	V	CLP SAS	7	-	3 UG	-	1	1	12	2		-	2
			COD	V	CLP SAS	V	CLP SAS	7	-	3 UG	-	1	1	12	2		-	2
			Cl	V	CLP SAS	V	CLP SAS	7	-	3 UG	-	1	1	12	2		-	2
			SO ₄	V	CLP SAS	V	CLP SAS	7	-	3 UG	-	1	1	12	2		-	2
			NH ₃	V	CLP SAS	V	CLP SAS	7	-	3 UG	-	1	1	12	2		-	2
			NO ₂ +NO ₃	V	CLP SAS	V	CLP SAS	7	-	3 UG	-	1	1	12	2		-	2

NOTES:

- ¹Assume bottle cleaning protocol submitted with QAPP acceptable.
- ²Total metals are defined as digestion and analysis of TAL metals on an unfiltered sample. Dissolved metals are defined as digestion and analysis of TAL metals on a sample filtered in the field.
- ³Water quality analyses will be done on unfiltered sample except for bromide which will be field filtered.

* MS/MSD samples required for organic analysis. Aqueous samples (groundwater, surface water, leachate, private well water) shall be collected, with extra sample volume at a frequency of one per 20 or fewer investigative samples. Triple the normal volume will be collected for VOAs and double the normal volume will be collected for BNA and PCB/P.

** Trip blanks will be shipped at a frequency of one per cooler of aqueous/sorbent tubes containing aqueous/sorbent tube samples for VOA analysis.

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TABLE 4-1

Sampling and Analysis Summary Table for Himco Dump Phase I

Sample Matrix	Field Parameters	DQO Level	Lab Parameters	DQO Level	Lab	Field Samples	Field QC					Total to Lab	Lab QC			Purpose of Samples
							BB ¹	BG	TB**	FB	FD		LD	MSD*	MS	
NEW WELLS GROUNDWATER (CONTINUED)			TKN	V	CLP SAS	7	-	3 UG	-	1	1	12	2	-	2	
			TP	V	CLP SAS	7	-	3 UG	-	1	1	12	2	-	2	
			TDS	V	CLP SAS	7	-	3 UG	-	1	1	12	2	-	-	
			TSS	V	CLP SAS	7	-	3 UG	-	1	1	12	2	-	-	
			alkalinity	V	CLP SAS	7	-	3 UG	-	1	1	12	2	-	2	
			bromide, dissolved	V	CLP SAS	7	-	3 UG	-	1	1	12	2	-	2	
SURFACE WATER (QUARRY, FISH PONDS)	Staff Gauge	1	TCL VOA	IV	CLP	12	-	-	1	2	2	16	-	1	1	Ecological and human risk assessment
	pH	1	TCL BNA	IV	CLP	12	-	-	-	2	2	16	-	1	1	
	Conductivity	1	TCL PCB/P	IV	CLP	12	-	-	-	2	2	16	-	1	1	
	DO	1	TAL Metals/CN (Total)2	IV	CLP	12	-	-	-	2	2	16	1	-	1	
	Temperature	1	Water Quality3	V	CLP SAS	12	-	-	-	2	2	16	1	-	1	
			COD	V	CLP SAS	12	-	-	-	2	2	16	2	-	2	
			Cl	V	CLP SAS	12	-	-	-	2	2	16	2	-	2	
			SO4	V	CLP SAS	12	-	-	-	2	2	16	2	-	2	
			NH3	V	CLP SAS	12	-	-	-	2	2	16	2	-	2	
			NO2+NO3	V	CLP SAS	12	-	-	-	2	2	16	2	-	2	
			TKN	V	CLP SAS	12	-	-	-	2	2	16	2	-	2	
			TP	V	CLP SAS	12	-	-	-	2	2	16	2	-	2	
			TDS	V	CLP SAS	12	-	-	-	2	2	16	2	-	-	
			TSS	V	CLP SAS	12	-	-	-	2	2	16	2	-	-	
			alkalinity	V	CLP SAS	12	-	-	-	2	2	16	2	-	2	
			bromide, dissolved	V	CLP SAS	12	-	-	-	2	2	16	2	-	2	

NOTES:

- ¹Assume bottle cleaning protocol submitted with QAPP acceptable.
 - ²Total metals are defined as digestion and analysis of TAL metals on an unfiltered sample. Dissolved metals are defined as digestion and analysis of TAL metals on a sample filtered in the field.
 - ³Water quality analyses will be done on unfiltered sample except for bromide which will be field filtered.
- Page 6 of 7

- * MS/MSD samples required for organic analysis. Aqueous samples (groundwater, surface water, leachate, private well water) shall be collected, with extra sample volume at a frequency of one per 20 or fewer investigative samples. Triple the normal volume will be collected for VOAs and double the normal volume will be collected for BNA and PCB/P.
- ** Trip blanks will be shipped at a frequency of one per cooler of aqueous/sorbent tubes containing aqueous/sorbent tube samples for VOA analysis.

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TABLE 4-1

Sampling and Analysis Summary Table for Himco Dump
Phase I

Sample Matrix	Field Parameters	DQO Level	Lab Parameters	DQO Level	Lab	Field Samples	Field QC					Lab QC			Purpose of Samples	
							BB ¹	BG	TB**	FB	FD	Total to Lab	LD	MSD*		MS
SEDIMENT (QUARRY, FISH PONDS, WETLANDS)			TCL VOA	IV	CLP	12	-	-	-	-	2	14	-	1	1	Ecological and human risk assessment
			TCL BNA	IV	CLP	12	-	-	-	-	2	14	-	1	1	
			TCL PCB/P	IV	CLP	12	-	-	-	-	2	14	-	1	1	
			TAL Metals/CN	IV	CLP	12	-	-	-	-	2	14	1	-	1	
WETLAND SOIL (GRAVEL PIT AREA (6), WETLAND REMNANT (4), OFF-SITE NW AREA (6))			TCL VOA	IV	CLP	16	-	-	-	-	2	18	-	1	1	Ecological and human risk assessment
			TCL BNA	IV	CLP	16	-	-	-	-	2	18	-	1	1	
			TCL PCB/P	IV	CLP	16	-	-	-	-	2	18	-	1	1	
			TAL Metals/CN	IV	CLP	16	-	-	-	-	2	18	1	-	1	
RESIDENTIAL BASEMENT AIR	Methane Hydrogen Sulfide	1 1													Determine if landfill gas migrating off-site	

NOTES:

¹ Assume bottle cleaning protocol submitted with QAPP acceptable.

* MS/MSD samples required for organic analysis. Aqueous samples (groundwater, surface water, leachate, private well water) shall be collected, with extra sample volume at a frequency of one per 20 or fewer investigative samples. Triple the normal volume will be collected for VOAs and double the normal volume will be collected for BNA and PCB/P.

** Trip blanks will be shipped at a frequency of one per cooler of aqueous/sorbent tubes containing aqueous/sorbent tube samples for VOA analysis.

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TABLE 4-2

SAMPLE VOLUMES, CONTAINERS AND PRESERVATION TECHNIQUES
HIMCO DUMP RI/FS

<u>Sample Matrix</u>	<u>Analyses</u>	<u>Container</u>	<u>Preservative</u>	<u>Maximum Holding Time</u>	<u>Volume</u>
Cap Soil	Consolidation, triaxial shear	Two 3-ft. thin wall Shelby tubes	None	None	Full
Cap Soil Soil Borings	Grain size, Atterberg limits	Quart Mason jars	None	None	Full
Cap Soil, Soil Borings, Sediment	TCL VOA	Two 120-ml wide mouth glass vials	4°C, no headspace	10 Days	Full
	TCL BNA and TCL PCB/P	One 8-oz. wide mouth glass jar	4°C	10 days to extraction 40 days to analysis	3/4 Full
	TAL Metals	One 8-oz. wide mouth glass jar	None	Metals: 180 days Hg: 26 days CN: 12 days	3/4 Full
Soil Borings	Permeability	3-ft. thin wall Shelby tube or quart Mason jars	None	None	Full
Waste Mass Gas	TCL VOA	One charcoal/Tenax sorbent tube One Tenax sorbent tube	-20°C	7 days	Not Applicable
Groundwater, Leachate, Surface Water	TCL VOA*	Two 40-ml glass vials with teflon septa	4°C, 1-2 drops HCL to pH <2, no headspace	10 days	Full
	TCL BNA and PCB/P*	Two 80-oz. amber glass bottles OR Four 1-liter amber glass bottles	4°C	5 days to extraction 40 days to analysis	Fill to neck
	TAL Metals (total)	1-liter polyethylene bottle	5 ml 50% HNO ₃ , per liter to pH <2	Metals: 180 days Hg: 26 days	Fill to neck
	TAL Metals (field filtered)	1-liter polyethylene bottle	5 ml 50% HNO ₃ , per liter to pH <2	Metals: 180 days Hg: 26 days	Fill to neck
	Cyanide	1-liter polyethylene bottle	4°C, 5 ml 6N NaOH per liter to pH >12	14 days	Fill to neck
Groundwater, Leachate, Surface Water, Private Well Water	<u>Water Quality I</u> Chloride Sulfate TDS TSS Alkalinity	<u>Water Quality I</u> Two 1-liter polyethylene bottles	4°C for all	Chloride: 28 days Sulfate : 28 days TDS: 7 days TSS: 7 days Alkalinity: 14 days	Chloride: 50 mls Sulfate: 50 mls TDS: 100 mls TSS: 100 mls Alkalinity: 100 mls

TABLE 4-2
 SAMPLE VOLUMES, CONTAINERS AND PRESERVATION TECHNIQUES
 HIMCO DUMP RI/FS
 (continued)

<u>Sample Matrix</u>	<u>Analyses</u>	<u>Container</u>	<u>Preservative</u>	<u>Maximum Holding Time</u>	<u>Volume</u>
Groundwater, Leachate, Surface Water, Private Well Water (cont.)	<u>Water Quality II</u> TP TKN NH ₃ NO ₂ + NO ₃ COD	<u>Water Quality II</u> Two 1-liter polyethylene bottles	4°C, 1 ml H ₂ SO ₄ per liter to pH <2	TP: 28 days TKN: 28 days NH ₃ : 28 days NO ₂ +NO ₃ : 28 days COD: 28 days	TP: 125 mls TKN: 500 mls NH ₃ : 500 mls NO ₂ +NO ₃ : 100 mls COD: 50 mls
	Bromide (field filtered)	One 250-ml polyethylene bottle	None	48 hours	100 mls
Private Well Water (CRL and/or CLP & SAS)	VOA*	Three 40-ml glass vials	4°C, no headspace	7 days	Full
	BNA and PCB/P*	Three 1-liter amber glass bottles	4°C	5 days to extraction 40 days to analysis	Full
	Metals	1-liter polyethylene bottle	5 ml 50% HNO ₃ per liter to pH <2	180 days	1 liter
	Cyanide	1-liter polyethylene bottle	4°C, 5 ml 6N NaOH per liter to pH >12	12 days	1 liter
	Mercury	1-liter polyethylene bottle	10-ml preservative to yield 0.05% (w/v) K ₂ Cr ₂ O ₇ and 0.5% (w/v) HNO ₃	26 days	500 mls

NOTES:

(CRL) U.S. EPA Region V Central Regional Laboratory proposed for analysis, CLP SAS may also be used

* Triple volume must be collection for MS/MSD analyses for volatiles, double volume must be collected for BNA & PCB/P analyses.

TABLE 4-3

SOIL SAMPLING PLAN RATIONALE

<u>SAMPLE NUMBERS</u>	<u>RATIONALE</u>
GS01-GS12	- Characterize nature and extent of contamination of soil and calcium sulfate used to construct final cover. - Assess human health risk by direct contact or ingestion.
GE01-GE05	- Shelby tube samples of the waste for Consolidated Undrained Triaxial Compression Testing to determine strength properties of the waste to be used in deep seated slope stability cap design calculations.
GE06-GE07	- Shelby tube samples of the waste for One-Dimensional Consolidation testing to predict the expected settlement during cap design.
GE08-GE12	- Samples for Atterberg Limits to determine physical characteristics of the waste.
GE13-GE17	- Samples for Grain Size Testing to determine physical characteristics of the waste.

14. Field notebook.
15. Camera and film.
16. Sample coolers and ice.
17. Small grass clippers

4.1.3 Soil Sampling Procedures

Each sample location will be located and marked on a systematic grid using survey stakes. Soil sampling locations are presented in Figure 4-1. A separate Soils Data Form will be completed for each sample. Sample locations will be evenly distributed within each area of the Site unless physically unaccessible or restricted by structures or surface debris. Sampling areas will be photographed.

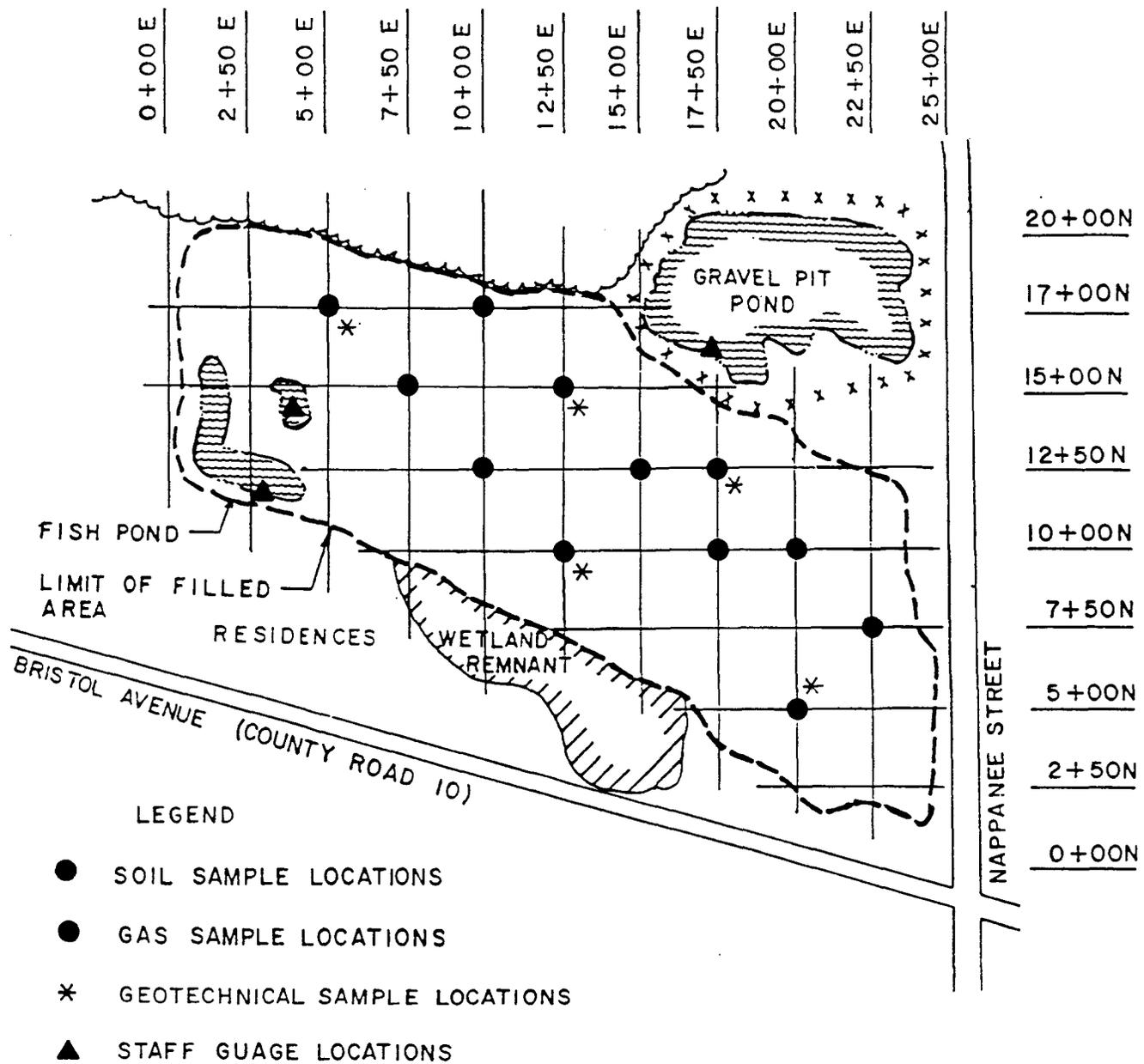
The following discussion separately addresses the specific soil sampling procedures for each of the two areas to be sampled (landfill cover geotechnical and analytical samples).

4.1.3.1 Soil Sampling of Existing Landfill Cover

Twelve soil samples will be collected from the vegetated areas of the site from approximately the 6- to 18-inch depth. Sampling locations will be determined using a systematic grid (Figure 4-1). Upon reaching a sample location, vegetation which hinders the collection of samples will be cut away using a small grass clippers. The sampler will attempt to collect a sample of only the white powdery matrix, which is believed to be predominately calcium sulfate. The sandy soil cover should not be collected. Each soil sample will be collected with a stainless steel hand trowel. Grab samples for volatile organic analysis will be collected immediately by filling two 128 ml vials with no head space. Additional soil will then be placed in a stainless steel bowl. Each sample will be classified (USCS) and examined for obvious signs of contamination. This information will be recorded on a Soils Data Form. A stainless steel spoon will be used to stir the soil until a homogeneous mixture is obtained. The soil mixture will be divided into quadrants and small samples will be taken from each quadrant and placed in appropriate sample jars. The containers and sample volumes required are listed in Table 4-2.

4.1.3.2 Geotechnical Sampling from Beneath Landfill Cover

Approximately 17 samples will be collected from beneath the existing topsoil cover. Approximate sample locations are shown in Figure 4-1. Upon reaching a sample location, a shovel or hydraulic device will be used to remove the cover soil and expose an area of landfilled waste that is predominately calcium sulfate. At each of the five locations the following samples will be collected: one sample for Atterberg limits placed in a quart mason jar; one sample for grain size testing placed in a quarter mason jar; and one three inch diameter, three-foot long Shelby tube for Consolidated Undrained Triaxial Compression testing. At two of the five locations an additional shelly tube will be pushed for one-dimensional Consolidation testing. The mason jar samples will be collected with a shovel. Each jar bag will be labeled for



SOURCE: US EPA, AUGUST, 1986

0 500 1000

SCALE: FEET
SCALE IS APPROXIMATE

Donohue APPROXIMATE SITE SAMPLING LOCATIONS



20026
MAY, 1990

FIELD SAMPLING PLAN
HIMCO DUMP SITE
ELKHART, INDIANA

FIGURE 4-1

location and sample number and inserted into a zip-loc bag for protection. The shelby tubes shall be pushed into the waste by a continuous and rapid motion without impact or twisting. The ends of the tube shall be sealed in accordance with ASTM standard D1587-74. After collecting the sample, the tubes will be handled carefully to prevent impacts or shocks that might cause fracturing within the sample thereby altering its strength characteristics. Each tube will be labeled for location and sample number and inserted into a heavy duty plastic packed in boxes with beans to prevent damage.

4.1.4 Decontamination

Before sampling and between each sample, all sampling equipment will be decontaminated with: (1) a soap and tap water wash, (2) a tap water rinse, (3) an isopropanol rinse, and (4) two rinses with deionized water.

Decontamination rinses will be retained in a closed container for eventual discharge to the municipal wastewater treatment system.

4.1.5 Quality Control

Table 4-1 lists samples needed for field quality control.

One field duplicate sample will be taken per 10 soil samples for metals and cyanide and one field duplicate will be taken per 10 samples for volatile organics, acid/base-neutral organics, and PCB/Pesticides. Field duplicates will be taken from the stainless steel mixing bowl at the same time and in the same manner as the original sample. VOA samples will not be mixed in the stainless steel bowl, they will be collected immediately. At locations where field duplicates are taken, two 8-ounce glass jars will be filled for metals/cyanide and two for organics. One of each of these will be sent as the original sample, and one will be sent as a field duplicate.

No equipment rinsate blank samples will be collected as the sampling equipment will be decontaminated between locations, and aqueous rinsate blank results supplied by the CLP in ug/l units are not easily correlated to soil (ug/kg) units.

The Site Manager and quality control auditor will perform one field audit during the soil sampling program. Field documentation will undergo an internal QC review after completion of field activities. Original field forms will be reviewed by the Site Quality Control Officer (SQCO) who will review for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

4.1.6 Documentation

Data collected and observations made during sample collection will be recorded on appropriate field forms included in Appendix A. Documentation will consist of:

1. Daily Time Log.
2. Photographs of all sample locations.
3. Soils Data Form.

4.2 GROUNDWATER SAMPLING PLAN

Approximate boring, monitoring well, and staff gauge locations are shown on Figure 4-2. The rationale for borehole, monitoring well, and staff gauge locations are summarized in Table 4-4. Groundwater will be sampled quarterly for one year; four sets of samples will be taken.

4.2.1 Soil Boring and Geotechnical Sampling

4.2.1.1 Introduction

A total of 10 wells will be drilled. Two will be 175 feet, two will be 100 feet, and six will be 20 feet below ground surface. The wells will be located in two nests of three and at four isolated locations as shown in Figure 4-2. Each nest will consist of one 175-foot well, one 100-foot well, and one 20-foot well. The four isolated wells will be 20 feet in depth. All wells will use 2-inch stainless steel casing. Depth to the bottom of the screen is shown in Table 4-7.

Soil samples will be collected every five feet from six of the 10 wells using 3 7/8-inch air rotary or hollow stem auger. These six wells are the two 175-foot wells and the four unnested 20-foot wells. These borings will further define the stratigraphy of the site and provide chemical information down to the water table. As discussed in Section 4.1.2.3 below, 30 soil samples will be collected for chemical analysis and 20 soil samples will be collected for geotechnical analysis. The boring numbers and their sampling depth are presented in Table 4-5.

Drilling, soil sampling, and monitoring well installation will be performed by a qualified drilling subcontractor under the direct supervision of a geologist or hydrogeologist who will visually inspect, classify according to U.S.C.S., log, and containerize soil samples. The drilling log and geotechnical analysis of select soil samples will be used to evaluate the physical characteristics of the subsurface material. These data, combined with water level, hydraulic conductivity, and chemistry results, will be used to aid in the selection and design of a remedial alternative.

TABLE 4-4

GROUNDWATER SAMPLING PLAN RATIONALE

	<u>SAMPLE NUMBERS</u>	<u>RATIONALE</u>
Boring:	BRG 01 - 06	- Characterize site stratigraphy. - Define confining layer - depth, extent, character, and surface.
New Wells:	WT102A P102B P102C	- Obtain unimpacted <u>upgradient</u> source of groundwater for chemical characterization. - Define horizontal and vertical flow gradients.
Existing: USGS Wells	B-1 - B-4 CP-1	- Calculate aquifer hydraulic characteristics. - Evaluate remedial action alternatives. - Comparison of USGS wells to newly constructed wells for groundwater quality and hydraulic characteristics.
New Wells:	WT101A P101B P101C	- Obtain <u>downgradient</u> source of groundwater for chemical characterization. - Assess risks from exposure by ingestion, inhalation, and direct contact. - Evaluate remedial action alternatives.
Existing: USGS Wells	O-1 M-1 M-2 E-2 E-3	- Comparison of USGS wells to newly constructed monitoring wells for groundwater quality and hydraulic characteristics. - Define horizontal and vertical flow gradients. - Characterize nature and extent of groundwater contamination.
Existing: USGS Wells	F-1 F-2 F-3 I-1 I-2 I-3	- Compare groundwater quality and hydraulic characteristics of upper unconfined aquifer and lower confined aquifer. - Define horizontal and vertical flow gradients. - Calculate aquifer hydraulic characteristics. - Characterize nature and extent of groundwater contamination. - Assess risks from exposure by ingestion, inhalation, and direct contact. - Evaluate remedial action alternatives.
New Wells:	WT103A WT104A WT105A WT106A	- Obtain <u>downgradient</u> source of groundwater for chemical characterization. - Define horizontal and vertical flow gradients. - Calculate aquifer hydraulic characteristics. - Characterize nature and extent of groundwater contamination.

TABLE 4-4
(Continued)

GROUNDWATER SAMPLING PLAN RATIONALE

	<u>SAMPLE NUMBERS</u>	<u>RATIONALE</u>
Existing: USGS Wells	N-1 Q-1 G-1, G-3 J-1, J-2, J-3	- Assess risks from exposure by ingestion, inhalation, and direct contact. - Evaluate remedial action alternatives.
	Twelve Private Residence Wells	- Characterize nature and extent of groundwater contamination of upper confined and lower confined aquifer. - Assess risks from exposure by ingestion, inhalation, and direct contact.
	Staff Gauges	- Complete water table contour map.

TABLE 4-5

BORINGS AND MONITORING WELL DESIGNATIONS

<u>Well Designation</u>	<u>Approximate Screened Interval (Feet Below Ground Surface)</u>	<u>Boring Number</u>	<u>Sampling Depth (Feet Below Ground Surface)</u>
WT101A	10- 20	None	175
P101B	95-100	None	
P101C	170-175	BRG-1	
WT102A	10- 20	None	175
P102B	95-100	None	
P102C	170-175	BRG-2	
WT103A	10-20	BRG-3	20
WT104A*	10-20	BRG-4	20
WT105A*	10-20	BRG-5	20
WT106A*	10-20	BRG-6	20

* Based upon the presence or absence of the clay confining unit in these areas, the well screen may be placed just above the top of the clay confining layer. Determination will be made in the field based upon lithologic information.

4.2.1.2 Equipment

Equipment and materials used during soil boring and geotechnical sampling activities will include:

1. Fully-equipped drill rigs capable of:
 - a. Accomplishing soil boring with 4 1/4-inch ID Hollow Stem Augers or 3 7/8-inch Tricone mud rotary methods to an approximate 175-foot depth.
 - b. Performing intermittent or continuous sampling to include 2-inch (I.D.) standard or stainless split-spoon samplers, Shelby tubes, or other continuous sampling system.
 - c. Providing penetration test information for soils.
 - d. Completing well installation.
2. Fiberglass tape of adequate length to measure depth of boring.
3. Electric water level indicator of adequate length (100 feet).
4. Generator, steam cleaner, and related equipment.
5. Tap water.
6. Camera and film.
7. Munsell Soil Color Chart.
8. Hard hat, safety glasses, and steel-toed shoes.
9. Field logs and data forms.
10. Field notebook.
11. Indelible marking pen and black ink pen.
12. Sample jars (as listed in Table 4-2), labels, tags, and forms.

4.2.1.3 Drilling and Sampling Procedures

Borings will be advanced using Hollow Stem Auger or air rotary techniques. The deepest boring at each well location will be sampled at five foot depth intervals unless the geologist or hydrogeologist determines in the field that more frequent sampling intervals are necessary. Samples will be retrieved using a split-spoon sampler or shelly tube. The geologist or hydrogeologist will classify and log the samples using the U.S.C.S. and Munsell Soil Color Chart. Samples will be stored in labeled 8-ounce glass jars. During the installation of the ten new monitoring wells, a maximum of 86 possible soil samples could be obtained by collecting a soil sample every five feet. Of the 86 soil samples collected 30 will be selected for chemical analysis. Of the 30 samples collected for chemical analysis 14 will be collected at the well nests (7 per nest) and 16 will be collected at the unnested locations (4 at leach location). The 30 soil samples will be selected by the field geologist based upon visual inspection and field screening with a photoionization detector every five feet, from five feet below the surface to five feet below the water table. If the field geologist notes any unusual evidence of visual staining, zone of saturation, high HNu values, presence of clay and/or encrustation of grains, additional samples may be taken.

In addition, of the 86 soil samples collected two at each well nest location (4 total) will be sent to the laboratory for geotechnical testing; a sample of the fine-grained confining unit described in USGS report will be taken if encountered. Samples will be tested for grain size distribution by sieve or hydrometer methods. If applicable, up to three samples will also be tested for Atterberg Limits and laboratory permeability. The number of samples was selected based on the criteria used in the "Soil Sampling Quality Assurance User's Guide" EPA/600/8-89-046. A 99% confidence interval with 95% power was selected. The historical coefficient of variation and minimum detectable difference as defined by the U.S. EPA Contract Laboratory Program data was used in the calculation of the n of 10. Soils will also be screened for radioactivity with a Geiger Counter. In order to prevent cross contamination the split spoon sampler will be decontaminated between samples by methods described below.

4.2.1.4 Decontamination

Upon mobilization to the site, and in between well nests, the drill rig, drilling tools, and sampling equipment will be decontaminated to minimize the potential for cross-contamination. The drilling subcontractor will supply all equipment necessary to steam-clean the drilling equipment and construct a temporary decontamination pad. The decontamination procedure will involve steam-cleaning the drill rig, drilling tools, and sampling equipment in a predetermined location away from the groundwater monitoring wells. The split spoon will be rinsed between samples with fluids and a tap water rinse. Wash water resulting from this activity and decontamination rod will be collected and discharged to the municipal wastewater treatment system.

4.2.1.5 Quality Control

The Site Manager and quality control auditor will perform one field audit during the well installation program. Field documentation will undergo an internal QC review after the completion of field activities. Original field forms will be reviewed by the SQCO for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

4.2.1.6 Documentation

Soil boring information and other observations made by the on-site geologist during drilling activities will be recorded on the appropriate field forms shown in Appendix A. This will include:

1. Daily Time Logs.
2. Soil Boring Logs.
3. Atmospheric Monitoring Logs.
4. Photographs and descriptions.

Photographs of soil boring samples will be processed and labeled with adhesive documentation labels.

4.2.2 Monitoring Well Installation

4.2.2.1 Introduction

A maximum of ten new groundwater monitoring wells will be installed at depths ranging from 20 to 175 feet. Approximate locations are shown on Figure 4-2. Actual finished depths will depend on the water table and site stratigraphy as determined in the field by the site geologist. Final well screen placement will be determined in the field. Depth will be dependent upon the presence or absence of clay confining unit. If present, well will be placed at the bottom of the uppermost aquifer. Proposed wells include six water table observation wells, two intermediate and two deep monitoring wells. The installation of well nests and monitoring wells adjacent to the existing USGS wells will provide verification of the integrity of the existing wells. This verification will be for results of chemical analyses, water levels and vertical hydraulic gradients. If there are comparable data results between the new and existing wells, additional existing well data can be used with confidence.

4.2.2.2 Equipment

Equipment to be used during monitoring well installation activities will include:

1. Drill rig(s) with the capability of:
 - a. Advancing soil borings for well installation with 4-1/4-inch (I.D.) hollow-stem augers (with knock-out plug) or using air rotary methods, a rig capable of driving 6-inch steel casing to an approximate 175 foot depth.
 - b. Completing monitoring well installation.
2. Fiberglass tape of adequate length to measure the bottom of the well.
3. Electric water level indicator of adequate length (100 feet).
4. Field notebook and field documentation forms.
5. Tap water.
6. Liquinox detergent.
7. Generator, steam cleaner, and related equipment.
8. Brush to clean split spoon.
9. Camera and film.
10. Well construction materials to be supplied by drilling subcontractor include:
 - a. Two-inch (I.D.), flush-threaded 0.010-inch slot Schedule 40 stainless steel screen.
 - b. Two-inch (I.D.), flush-threaded Schedule 40 stainless steel riser pipe.
 - c. Rubber O-rings or teflon-thread wrap tape.
 - d. Two-inch (I.D.), flush-threaded stainless steel cap and bottom plug.
 - e. Neat cement, cement-bentonite, or Volclay grout.

- f. Bentonite pellets.
 - g. Washed, well-sorted No. 50 silica sand.
 - h. Four-inch nominal diameter steel protective casing with locking cover.
 - i. Keyed-alike locks.
- 11. Isopropanol (A.C.S.).
 - 12. pH dissolved oxygen, and conductivity meters.
 - 13. Thermometer.
 - 14. Five-gallon container to collect equipment decontamination rinsate.
 - 15. Keck pump with back-flow check valve.

4.2.2.3 Well Installation Procedures

The minimum borehole diameter for monitoring well installation will be 3-7/8 inches. Water table and piezometer wells will be constructed of 2-inch (I.D.), flush-threaded 0.010-inch slot, Schedule 40 or 80 stainless steel well screens with Schedule 40 or 80 stainless steel riser. Screen lengths will be 10 feet for water table observation wells and 2 or 5 feet for piezometer wells. If the subsurface conditions allow, piezometers will be installed approximately 10 feet away from a proposed water table observation well or existing USGS well to form a well nest.

Wells constructed inside hollow stem augers will be set, and then the augers will be pulled. Wells installed inside steel casings will be finished inside casing which will be left in place. The well screen portion of the well will not be set inside the casing, but below the bottom of the casing.

Due to the shallow depth to the water table (5 to 18 feet), water table observation wells will be constructed as follows. The annular space between the well screen and the borehole wall will be backfilled with No. 50 sand and will extend 1 foot above the well screen. The well screen will set so the water table intersects the screen 2 feet from the top of the screen. The remaining 5 feet of the borehole annular space from the ground surface down to the top of the filter pack is required for well construction materials which include a 3-foot cement collar and a 2-foot bentonite seal.

The piezometers will be constructed as follows: Well installation will begin by wrapping teflon tape or using O-rings, threading together sections of the stainless steel well, and lowering the connected sections down into the borehole. The annular space between the well screen and borehole wall will be backfilled with No. 50 sand filter pack to a depth of 2 feet above the top of the well screen. Placement of the filter pack will be followed by the installation of a 5-foot bentonite pellet seal. From the lower pellet seal to 6 feet from ground surface, annular space in piezometer well installations will be backfilled with a bentonite/cement or Volclay grout. An upper 2-foot bentonite pellet seal will be installed at 6 feet from ground surface. Both piezometers and observation wells will be finished to ground surface with a cement/bentonite or neat cement collar around the stainless steel riser. A 4-inch diameter steel protective casing with locking lid will be cemented in

place over the stainless steel riser. Stainless steel risers will be provided with vented caps. A typical well construction diagram for a water table or piezometer is shown in Appendix B.

Wells will be developed after a minimum of 24 hours has elapsed following the completion of well construction. Well development will consist of pumping the well using a submersible pump. Intermittent surging will be performed, if appropriate, to aid in removal of fine-grained material. Well development will continue until at least five well volumes have been removed and the water being removed from the well has the following characteristics:

- ° Water is silt free.
- ° Water temperature is stabilized to $\pm 0.5^{\circ}\text{C}$.
- ° pH is stabilized to ± 0.1 units.
- ° Conductivity is stabilized to ± 10 percent.

Field instruments will be calibrated before use as described in Appendix C. The calibration results will be recorded on Field Meter Instrument Calibration Logs (Appendix A).

4.2.2.4 Decontamination

Soil boring and monitoring well installation equipment will be decontaminated upon arrival on-site and between well locations to avoid the possibility of cross-contamination. Decontamination of drill rigs, vehicles, and other equipment will be accomplished with high-pressure hot-water steam cleaning. Additional scrubbing may be required to remove encrusted material.

Decontamination of the riser, well screens, and end caps will consist of high-pressure hot-water steam cleaning. Workers shall use clean cotton gloves when handling riser and well screen. Decontamination of well development equipment will consist of: soap and water wash, followed by a tap water rinse, an isopropanol rinse, (Distilled water only in keck pump) and two rinses with deionized water. Wastewater fluids generated during drilling, and water removed from the wells during development, will be disposed of in the municipal wastewater treatment facility. Decontamination rinses containing isopropanol will be containerized for discharge to the municipal wastewater treatment system.

4.2.2.5 Quality Control

Field documentation will undergo an internal QC review after the completion of field activities. Original field forms will be reviewed by the SQCO who will review the field forms for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

4.2.2.6 Documentation

Data collected and observations made during the installation of the monitoring wells will be recorded on the appropriate field forms included in Appendix A. Documentation will include:

1. Daily Time Log.
2. Water Table Observation Well Installation Diagram.
3. Piezometer Installation Diagram.
4. Well Development Form.
5. Field Meter Instrument Calibration Logs.
6. Atmospheric Monitoring Log.

4.2.3 Hydraulic Characterization

4.2.3.1 Introduction

Following the development of the monitoring wells, field hydraulic conductivity tests (slug tests) will be conducted and water level measurements will be taken to determine the hydraulic characteristics of the aquifer. The procedures to be followed during aquifer hydraulic characterization are presented in this section. New wells and existing USGS wells to be slug tested are presented in Table 4-6.

4.2.3.2 Equipment

Equipment includes the following:

1. Stainless steel slug.
2. Rope or cord.
3. Watch with a second hand.
4. Electric water level indicator.
5. Water level data logger with pressure transducer.
6. Data log book.
7. Field documentation forms.
8. Liquinox detergent.
9. Deionized water.
10. Tap water.
11. Isopropanol (A.C.S.).
12. Five-gallon pail with cover to collect decon rinsate.

4.2.3.3 Procedures

In-Field Hydraulic Conductivity Testing

All wells will be slug tested following well development to determine the hydraulic conductivity of the formation materials near each well. Both falling and rising head tests will be recorded on an in-field permeability form included in Appendix A.

TABLE 4-6

IN-FIELD HYDRAULIC CONDUCTIVITY TESTING

Existing USGS Wells:	M-1
	M-2
	E-3
	F-1
	F-2
New Wells:	WT102A
	P102B
	P102C
	WT101A
	P101B
	P101C
	WT103A
	WT104A
	WT105A
	WT106A

The pressure transducer will be lowered below the static water level to a depth which allows the slug to be lowered into the water without coming into contact with the transducer. The maximum transducer depth will be limited by the settings of the data logger and will be addressed when setting up the test. The rising or falling water level produced by dropping the slug into or pulling the slug out of the water will be recorded by a data logging device. A computer program using the Bouwer and Rice (1976) method of slug test analysis will be used to calculate the hydraulic conductivity values.

Water Level Measurements

Water level and well depth measurements will be taken after installation of the new wells, before and after well development and during the scheduled groundwater sampling event. Site conditions at the time of measurements, rain events, and well integrity will also be noted. Static water levels will be measured and recorded for the purpose of determining groundwater flow directions and gradients at the site. The water level surface will be measured using a popper or electric water level indicator. Each well will have a reference point indicated on the top of the PVC well casing from which water level measurements will be taken. Measurements will be noted to the nearest 0.01 feet. A reference point elevation on the well will be established by survey with respect to mean sea level elevation with an accuracy of 0.01 feet.

Stream level measurements at staff gauges will be taken on the same days as groundwater elevations from the monitoring wells so interconnection of the stream and groundwater can be evaluated.

4.2.3.4 Decontamination

All slugs or bailers and water level measurement equipment, with the exception of the pressure transducer, will be decontaminated before use and at each well location as follows:

1. Wash with soap and water solution.
2. Rinse with tap water.
3. isopropanol rinse
4. Rinse twice with deionized water.

A distilled water rinse only (with no soap and water) will be used to decontaminate the pressure transducer.

4.2.3.5 Quality Control

Field documentation will undergo an internal QC review after the completion of field activities. Original field forms will be reviewed by the SQCO who will review the field forms for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

4.2.3.6 Documentation

Data collected and observations made during in-field permeability tests and water level measurements will be recorded on the appropriate field documentation forms in Appendix A. Forms will consist of:

1. Daily time logs.
2. In-field permeability form.
3. Water elevation form.

4.2.4 Groundwater Sampling

4.2.4.1 Introduction

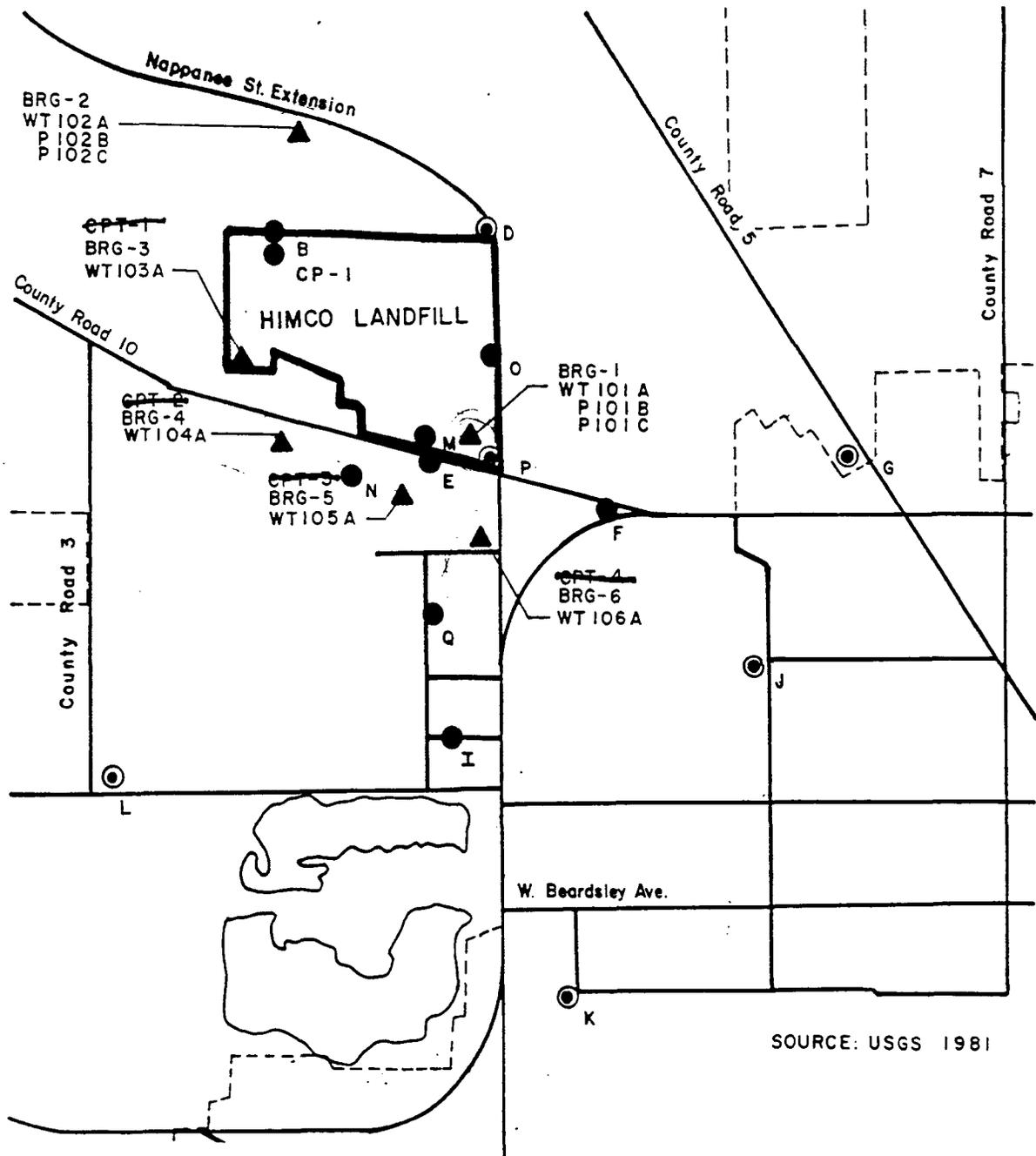
New and existing groundwater monitoring wells, as well as six shallow wells and six deep wells at private residences (twelve total) directly south of Himco Dump, will be sampled in order to determine the vertical and horizontal extent and degree of contamination of the uppermost aquifer and lower confined aquifer. Locations of the monitoring wells to be sampled are shown in Figure 4-2. A list of existing USGS wells to be sampled is presented in Table 4-7. P-1 will not be sampled because no riser was found and the well water is full of silt and sediment. Groundwater samples from new and existing monitoring wells will be analyzed for Target Compound List (TCL), VOC, BNA, PCBs/pesticides, TAL metals/cyanide, and water quality. The twelve private wells will be analyzed for TCL VOA, BNA, PCBs/pesticides, TAL metals/cyanide, and water quality.

Sample integrity will be maintained by decontaminating field equipment between wells and adhering to U.S. EPA sample preservation, packaging, and chain-of-custody protocol.

4.2.4.2 Equipment

The equipment to be used for groundwater sampling consists of:

1. Keck pump with back-flow check valve.
2. Electric water level indicator, water level popper, or teflon-coated woven tape.
3. Field notebook.
4. Millipore field filtration apparatus.
5. 0.45-millimeter filters.
6. Nitrogen gas cylinder and regulator for filtering apparatus.
7. Conductivity meter - Yellow Springs or equivalent.
8. pH meter and pH 7 and 10 calibration buffer solutions - Orion or equivalent.
9. Tap water, deionized water, and A.C.S. isopropanol.
10. Five-gallon pail with cover for collecting and storing isopropanol rinses.
11. Liquinox detergent.
12. EPA Region V sample tags and SMO traffic report labels.



SOURCE: USGS 1981

LEGEND

- BRG BORING
- ~~CPT~~ ~~CONE PENETRATION TEST LOCATION~~
- EXISTING USGS WELL NEST TO SAMPLE
- ▲ PROPOSED MONITOR WELL
- ⊙ EXISTING USGS WELL NEST

NOT TO SCALE

Donohue

20026
MAY, 1990

Engineers • Architects • Scientists

BORING, MONITORING WELL AND EXISTING USGS WELL LOCATIONS

FIELD SAMPLING PLAN
HIMCO DUMP SITE
ELKHART, INDIANA



FIGURE 4-2

TABLE 4-7

USGS WELLS USED IN THE SAMPLING EVENT

<u>WELL DESIGNATION</u>	<u>DEPTH TO BOTTOM OF SCREEN</u>
B-1	495 ft.
B-2	12 ft.
B-3	129 ft.
B-4	173 ft.
CP-1	20 ft.
E-2	17 ft.
E-3	174 ft.
F-1	32 ft.
F-2	153 ft.
F-3	15 ft.
G-1	50 ft.
G-3	169 ft.
I-1	172 ft.
I-2	15 ft.
I-3	35 ft.
J-1	40 ft.
J-2	18 ft.
J-3	152 ft.
M-1	24 ft.
M-2	103 ft.
N-1	30 ft.
O-1	20 ft.
Q-1	20 ft.

13. Plastic sheeting.
14. Sample containers and preservatives as listed in Table 4-2.
15. HDPE filtration jugs.
16. pH paper.
17. Coolers.
18. "Blue" ice or equivalent.
19. Plastic containers for transport of sampling equipment to the site.
20. Large plastic garbage bags to store used plastic sheeting, etc.

4.2.4.3 Groundwater Sample Collection Procedures

In order to prevent contamination during transport to the site, all sampling equipment will be stored in clean plastic containers. A new sheet of clean plastic sheeting will be used at each sampling location to provide a clean surface on which to place sampling equipment during sample collection. Used sheeting will be stored in plastic garbage bags.

Before beginning the purging process, field meters will be calibrated according to procedures outlined in Appendix C. The results of the meter calibrations will be recorded on the field meter instrument calibration logs in Appendix A.

Before pumping begins, the volume of water to be removed from the well must be determined. At least five times the measured volume will be purged. To measure the well volume, the depth to the static water level and to the bottom of the well will be measured from the survey reference point. The measuring tape will be rinsed several times with distilled water between measurements at each well. By using the depth to water, well depth, and well radius, the volume of standing water in the well (well volume) will be calculated using the following equation:

$$\text{well volume (gallons)} = 3.14r^2 \times h \times 7.48 \text{ gallons/ft}^3$$

where r = well radius (feet) and h = water height (feet).

Before pumping begins with the Keck pump, and after each of the five well volumes is removed, measurements of pH, conductivity, temperature, and turbidity will be recorded on the Well Purging and Sample Collection Form included in Appendix A. Pumping should continue until the readings have stabilized to pH ± 0.1 unit, conductivity ± 10 percent, temperature $\pm 0.5^\circ\text{C}$. The total volume of water removed during the purging process will be recorded. The water level will be recorded as soon as possible after the purge pump is removed from the well. If the rate of the recovery of the water level as it rises back to the static level is slow enough, water level measurements versus time in seconds will be recorded. If the conductivity exceeds 5,000 mmhos/cm, a note on the SAS packing list will indicate the conductivity reading and state "check for possible chloride interference."

Following the well purging process, groundwater samples will be collected with the Keck pump. The time between the completion of purging and collection of the sample is not to exceed 24 hours unless the rate of recovery of the well requires more time for a sample to collect in the well.

Table 4-2 summarizes sample containers and preservatives to be used. Following the addition of any chemical preservative, sample pH will be checked in the field with pH paper to ensure that adequate preservative was added.

Samples for dissolved metals and bromide analysis will be collected in a HDPE filtration jug and filtered immediately. The details of the filtering process are included in Appendix C. Following field filtering, the metals aliquot will be preserved with nitric acid. The pH of the preserved sample will be checked to ensure that adequate preservative was added. No preservative will be added to the bromide aliquot. Performance of field-filtering will not be indicated on paperwork accompanying metals samples to the lab because these samples will be digested in order to analyze the "total dissolved" fraction of metals. Samples for total metals will not be field filtered.

Samples obtained from the private residences will be taken directly from the tap (deep wells) after letting it run for approximately five minutes. Samples obtained from the shallow wells which have not been in use for approximately ten years, will be taken directly from the well head. Well purging will be accomplished by the same methodology described above.

All samples will be stored in coolers containing blue ice or its equivalent in a locked secure area until custody is relinquished.

4.2.4.4 Decontamination

The outer parts of the Keck pump which come into contact with groundwater will be cleaned between wells by: 1) Liquinox and water wash, 2) tap water rinse, 3) isopropanol rinse, and 4) two deionized water rinses. The inner parts of the Keck pump will be cleaned by pumping one gallon of distilled water through the pump and tubing system in between well locations. Decontamination rinses will be containerized for eventual discharge to the municipal wastewater treatment system.

4.2.4.5 Quality Control

In order to verify the quality of the sampling process, sample blanks and duplicates will be collected during the sampling process. The number of QC samples to be collected is listed in Table 4-1. Samples selected for matrix spike analysis will require additional the volume as listed in Table 4-2.

Field blanks will be taken at a frequency of one per every ten field samples collected. Field blanks will be collected for each sampling round. Field blanks for dissolved metals must be field-filtered using the procedure in Appendix C. Field blank samples will be collected after the decontamination procedure in Section 4.2.4.4 by pumping distilled water through the Keck pump and collecting the water in the appropriate bottles listed in Table 4-2.

Field duplicates will be collected at the frequency of one duplicate during the collection of every ten field samples. A field duplicate sample is a second sample collected consecutively from one well using the decontaminated Keck pump.

Field documentation will undergo an internal QC review after the completion of field activities. Original field forms will be reviewed by the SQCO who will review the field forms for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

4.2.4.6 Documentation

Data collected and observations made during groundwater sampling will be recorded on the following field documentation forms (Appendix A):

1. Daily Time Log.
2. Well Purging and Sample Collection Form.
3. Well Development Form.
4. Field Meter Instrument Calibration Log.

4.2.5 Cone Penetrometer Test

4.2.5.1 Introduction

Cone penetrometry will be used in four wells to further define the stratigraphy of the site. Specifically, this method will determine if the unconfined/confined aquifer sequence is present where wells are constructed. Approximate locations are shown on Figure 4-2.

4.2.5.2 Equipment

Equipment and materials used during the cone penetrometer test will include:

1. Hydraulic ram to push rods into ground.
 - a. Twenty tons of ballast, mounted on the truck, used to counteract the thrust of the hydraulic rams.
2. Penetrometer with electronic friction sensors.
 - a. Spare penetrometers and sampling probes.
3. Two data acquisition and analysis computers.
4. Electrical generator.
5. Lighting.
6. Compressed air.
7. Vacuum pumps.
8. Grouting and high pressure wash pumps.
9. Water tanks.

4.2.5.3 Procedures

The cone penetration test (CPT) uses high capacity hydraulic rams to smoothly push small diameter probes deep into the ground at a constant rate of 4 feet per minute. Miniature electronic sensors mounted inside the probes measure end bearing resistance on the conical tip of the penetrometer and friction resistance along the sides of the penetrometer. These resistances are directly proportional to the soil failure strength and provide an immediate and continuous record of geotechnical subsurface conditions.

4.2.5.4 Decontamination

Decontamination will involve steam cleaning the equipment, primarily the penetrometer cone and rods, and discharging the wastewater to the municipal wastewater treatment system.

4.2.5.5 Quality Control

Field graphical displays of measurements will undergo an internal QC review after the completion of field activities. Original field data will be reviewed for completeness, accuracy, and compliance with the FSP by the SQCO. Original field data will be stored on-site until completion of the field program, at which time all documentation will be relinquished to the Site Manager.

4.2.5.6 Documentation

Data collected during the cone penetrometer test will be recorded and displayed on a computer data acquisition system. Observations and equipment calibration checks will be recorded in a bound field notebook. A Daily Time Log (Appendix A) will also be completed. Graphical displays and any other field documentation records will be filed in locked file cabinets in a secure area.

4.3 SURFACE WATER HYDRAULIC MONITORING

4.3.1 Introduction

Three staff gauges will be installed on the Himco Dump site in the following surface water bodies:

1. The gravel pit pond.
2. Fish pond in southwest corner of site.
3. Other pond in southwest corner of site.

Data from these gauges will be used along with groundwater elevations from monitoring wells in the development of a water table map for the Himco Dump Site. Measurements at staff gauges will be taken on the same days as groundwater elevations from the monitoring wells so that interconnection of the surface water and groundwater can be evaluated. Rain events will be noted on the field forms.

4.3.2 Equipment

The following equipment will be used for hydraulic monitoring:

1. Two coupled galvanized-steel staff gauges labeled in 0.01-foot increments.
2. Sledge hammer and/or post driver.
3. Field notebook.
4. Camera and film.
5. Waders.
6. U.S.G.S. 7.5-minute quadrangle.
7. Bracket fasteners and wire.

4.3.3 Staff Gauge Monitoring Procedures

The staff gauges will consist of 2-inch diameter, coupled, galvanized pipe. The gauges will be clearly labeled in 0.01-foot increments. The gauges will be installed where easily accessible. Final installed locations and top of pipe elevations will be surveyed with respect to mean sea level elevation with an accuracy of 0.01 feet. The staff gauges will be securely driven into the pond bottoms so that water levels can be read from the pond bank. Surface water elevations will be recorded to the nearest 0.01-foot.

4.3.4 Decontamination

No decontamination is necessary.

4.3.5 Quality Control

Field documentation will undergo an internal QC review after the completion of field activities. Original field forms will be reviewed by the SQCO who will review the field forms for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

4.3.6 Documentation

Data collected and observations made as gauges are installed and monitored will be recorded on appropriate field forms (Appendix A). The documentation will consist of:

1. Daily Time Log.

2. Staff Gauge Information Form.
3. Photographs of staff gauge locations.

4.4 WASTE MASS GAS SAMPLING PLAN

4.4.1 Introduction

The characterization of the Himco Dump landfill gas is necessary to select appropriate remedial alternatives and develop the risk assessment. The typical landfill gas consists of methane, hydrogen sulfide, and selected volatile organics. Historical groundwater data indicates the presence of acetone, trans 1,2-dichloroethene, chloroethane, chlorofluoromethane, and dichlorodifluoromethane in shallow groundwater. No historical waste mass gas or ambient air data exists. Table 4-8 shows the waste mass gas sampling designations.

Ten of the 12 cap soil sampling locations as shown in Figure 4-1 will be selected for waste mass gas collection. The exact locations where samples will be collected will be determined based on the 10 highest field VOC readings or where the 10 highest methane or hydrogensulfide ambient concentrations as measured by the Lumidor Gasponder IV meter are noted. The sampling event will be scheduled on a calm, clear day to facilitate the extraction of the gas samples.

4.4.2 Equipment

The following equipment and materials will be used during waste mass gas sampling:

1. Lumidor Gasponder IV Model PGM-14 (for measurement of methane and hydrogen sulfide).
2. Hollow perforated steel soil probes, 4.5 feet x 1-inch max OD.
3. Probe driver.
4. Personal peristaltic sampling pump with 1/4-inch sampling port, fittings and adaptors to allow in tandem sample collection.
5. Soap bubble flow meter.
6. Hnu photoionization detector.
7. Stop watch.
8. Teflon tubing.
9. Tenax/charcoal sorbent tubes (supplied by CLP SAS lab).
10. Tenax sorbent tubes (supplied by CLP SAS lab).
11. Culture tubes (supplied by CLP SAS lab)
12. Friction-top can with charcoal for packaging
13. Freezer
14. Water, deionized and tap.
15. Isopropanol (A.C.S).
16. Five-gallon pail with cover to contain isopropanol rinses.
17. Liquinox soap.
18. Brushes.
19. EPA Region V sample tags and SMO traffic report labels.

TABLE 4-8

WASTE MASS GAS SAMPLING DESIGNATIONS

<u>Sample No.</u>	<u>Rationale</u>
TT-1	Exact locations will be determined based on 10 highest field VOC readings where the 10 highest methane in hydrogen sulfide ambient concentrations as measured by Lumidor Gasponder IV meter are noted.
TT-2	
TT-3	
TT-4	
TT-5	
TT-6	
TT-7	
TT-8	
TT-9	
TT-10	

20. Plastic bags.
21. Field notebook.
22. Camera and film.
23. Thermometer.
24. Polyester gloves.

4.4.3 Sample Collection Procedures

Details of the sample collection and field analysis for methane and hydrogen sulfide are contained in the SOP in Appendix E. The hollow perforated steel soil probe will be driven to at least three feet into the landfill. The exact depth will be recorded on the Field Atmospheric Monitoring Log. The probe will be allowed to equilibrate for five minutes. Teflon tubing will then be connected from the probe to the sampling pump/tandem sorbent tube assembly.

Based on historical groundwater quality data, maximum concentrations of volatile organics, and calculations done in accordance with Method T01, "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air," EPA-600/4-84-041, a sampling rate of 1,000 ml/min for 20 minutes will likely not result in sorbent tube saturation and allow detection of most volatile organics present at levels greater than 5 ng/tube. To verify this, two locations will be sampled on the first day of field activities using this flow rate and sent to the SAS lab for 24-hour turnaround to determine if the sampling rate was too fast.

Before the remainder of the samples are collected, calibration of an appropriate flow rate should be verified with a "dummy" pair of Tenax/charcoal and Tenax tubes in place. Initial calibration should be accomplished using a soap bubble flow meter. The flow meter is to be connected to the flow exit, as the entire flow system is sealed.

The flow rate should be checked before and after each sample collection. If the day's sampling event exceeds four hours, the flow rate should be checked at an intermediate point during the day as well. A rotameter is included on the pump to allow observation of the sampling flow rate without disrupting the sampling process.

To collect an air sample, the sorbent tubes are removed from the sealed culture tube just before the collection process begins. The glass tubes must be handled only with polyester gloves and should not contact any other surfaces. The glass tubes should be connected to the pump manifold using teflon ferrules and Swagelok (stainless steel or teflon) fittings. The pump should be started and the following parameters recorded on the Field Atmospheric Monitoring Log: date, sampling location, time, ambient temperature, barometric pressure, relative humidity, flow rate, rotameter reading, sorbent tube numbers and pump serial number. Some meteorological data will be based upon conditions (at the airport) and not taken directly in the field.

The sampler should operate for 10 minutes, and the initial operating parameters should be verified and recorded. At the end of the sampling period, the parameters should be recorded and the flow rate checked and recorded. If the flows at the beginning and end of the sampling period differ by more than 10 percent, the tubes should be marked as suspect.

The tubes should be removed from the pump manifold (one at a time) and placed in the culture tubes (use gloves). The culture tubes should be sealed in a friction-top can containing a layer of charcoal and packaged for immediate shipment to the laboratory for analysis. Cartridges should be stored in a freezer at a reduced temperature (e.g. - 20°C) before collection and shipped with ice to maximize storage stability.

The total volumetric flow for each cartridge should be calculated and recorded using the following equation:

$$V_m = \frac{T \times Q_A}{1000}$$

where

Q_A = flow rate in ml/minute

V_m = Total volume sampled in liters at measured temperature and pressure.

T_2 = Stop time

T_1 = Start time

T = Sampling time = $T_2 - T_1$, minutes

The total volume (V_s) at standard conditions, 25°C and 760 mmHg, should be calculated from the following equation and included on the chain of custody form so the CLP lab can report results in ug/m³:

$$V_s = V_m \times \frac{P_A}{760} \times \frac{298}{273 + t_A}$$

where

P_A = Average barometric pressure, mmHg

t_A = Average ambient temperature, °C

4.4.4 Decontamination

Decontamination of the steel soil probe will be done between borings using Liquinox and tap water wash, followed by a tap water rinse, an isopropanol rinse, and two rinses with deionized water. The sampling pump is decontaminated by pumping several liters of ambient air through it. Decontamination rinses containing isopropanol will be containerized for eventual discharge to the municipal wastewater treatment system.

4.4.5 Quality Control

The Site Manager and quality control auditor will perform one field audit during the waste mass gas sampling program. Field documentation will undergo an internal QC review after the completion of field activities. Original field forms will be reviewed by the Site Quality Control Officer (SQCO) who will review the field forms for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

One unexposed sorbent tube pair will be sent to the CLP SAS lab for analysis to serve as a bottle blank. Trip blanks consisting of an additional unexposed sorbent tube pair will be sent in each shipping cooler sent to the CLP SAS lab. An off-site location of similar soil type as the site will be sampled as a background sample. One location on the cap will be selected for a field duplicate. A single gas probe will be driven at this location and two sets of sorbent tubes will be collected using the same pump within 20 minutes of initial borehole equilibration.

4.4.6 Documentation

Data collected and observations made during collection of waste mass gas samples will be recorded on the appropriate field forms included in Appendix A. Documentation will include:

1. Daily Time Log.
2. Field Meter Instrument Calibration Logs.
3. Atmospheric Monitoring Log.

4.5 GEOPHYSICAL INVESTIGATION - ELECTROMAGNETIC AND MAGNETOMETER SURVEYS

4.5.1 Introduction

Standard procedures and equipment for completing the geophysical investigation at the Himco Dump site are described below. The geophysical investigation will be performed across the apparent filled area and its perimeter to assess the actual extent of landfilling which occurred across the site. The geophysical data will be referenced to a survey grid coordinate system staked at 100-foot centers throughout the landfilled area.

The electromagnetic survey will be accomplished with a Geonics EM-31 Terrain Conductivity Meter. This investigative technique will be used to delineate buried metallic and nonmetallic wastes, contaminated soils, and fill areas across major areas of the site to a maximum 15-foot depth. The maximum height of filling at Himco was reported to be 15 feet. If the water table lies within 15 feet of the ground surface, this method may also prove useful in identifying potential contaminant plumes downgradient of the dump site that may occur within the shallow groundwater system.

The magnetometer survey will be conducted across the same areas of the site as the terrain conductivity survey. Data obtained from the magnetometer survey will be used to assess whether the potential for buried drums or other metal debris exists.

4.5.2 Instrumentation and Equipment

Instrumentation - Electromagnetic (EM-31)

Electromagnetic instrumentation will include a Geonics EM-31-D Terrain Conductivity Meter, and an analog strip chart or digital recorder. The EM-31 terrain conductivity meter will measure both the quadrature-phase component (terrain conductivity measurement) and the in-phase component (sensitive to metallic objects). The analog strip chart or digital recorder will record both the quadrature-phase and in-phase components of the EM-31-D terrain conductivity meter output.

Equipment - Electromagnetic (EM-31)

1. Geonics Model EM-31 Terrain Conductivity Meter.
2. Analog strip chart or digital recording equipment.
3. Site base map.
4. Field notebook.

Instrumentation - Magnetic

Magnetic instrumentation will include an OMNI IV Tie-Line Magnetometer manufactured by EDA Instruments, Inc. The OMNI IV magnetometer will measure and digitally record both total field response, and the gradient of the magnetic field. The magnetic gradient will be measured by two sensors separated by a distance of 0.5 meters, mounted vertically and a hand-held 2.5-meter staff. Total field magnetic data will be collected from the upper gradient sensor. The hand-held 2.5-meter staff may be lengthened to reduce magnetic interference from metallic debris located at (or near) the ground surface. Field measurements will be digitally recorded by the instrument and subsequently downloaded to a microcomputer for data reduction and interpretation.

Equipment Magnetic

1. EDA Instruments, Inc., OMNI IV Magnetometer/Gradiometer
2. Microcomputer
3. Site base map
4. Field notebook

4.5.3 Data Collection Procedures

Electromagnetic

The electromagnetic survey will use portable equipment operated by a two-man crew. Each day, prior to data collection, instrumentation functional and field calibration checks will be completed according to the operation manual. All instrumentation checks will be conducted at a base station location free of instrument interference. Readings will be recorded daily in a bound field notebook. The electromagnetic data will be collected along north-south traverse lines which are spaced 25 feet apart and referenced to the staked survey grid. Grid coordinates will be hand-written on the strip chart record at regular intervals. The instrument will be returned to the base station to monitor for instrument calibration variations upon the completion of each day's activities.

Magnetic

The magnetic survey will be completed with portable equipment operated by a two-man crew. Each day, prior to data collection, instrumentation functional checks will be conducted in accordance with the operation manual. A magnetometer base station will be established at a location free of instrument interference. The base station will be monitored periodically to document fluctuations in the earth's magnetic field (diurnal variation) that occur during the magnetometer survey. The OMNI IV magnetometer allows correction of field survey data for diurnal variation by using the Tie-Line survey mode. Diurnal variation corrections will be calculated at the end of each day prior to downloading the field data to a microcomputer.

4.5.4 Decontamination

No decontamination is required.

4.5.5 Quality Control

Field documentation logs and analog or digital data will undergo an internal QC review after the completion of field activities. Original field data will be reviewed for completeness, accuracy, and compliance with the FSP by the SQCO. Original field data will be stored on-site until completion of the field program, at which time all documentation will be relinquished to the Site Manager.

4.5.6 Documentation

Data collected during the geophysical investigation will be recorded on analog strip charts or in a digital format, and later transferred to an IBM-compatible diskette. Observations and equipment calibration checks will be recorded in a bound field notebook. A Daily Time Log (Appendix A) will also be completed. Strip charts, diskettes, and other field documentation records will be filed in locked file cabinets in a secure area.

4.6 WETLANDS ASSESSMENT AND DELINEATION

4.6.1 Introduction

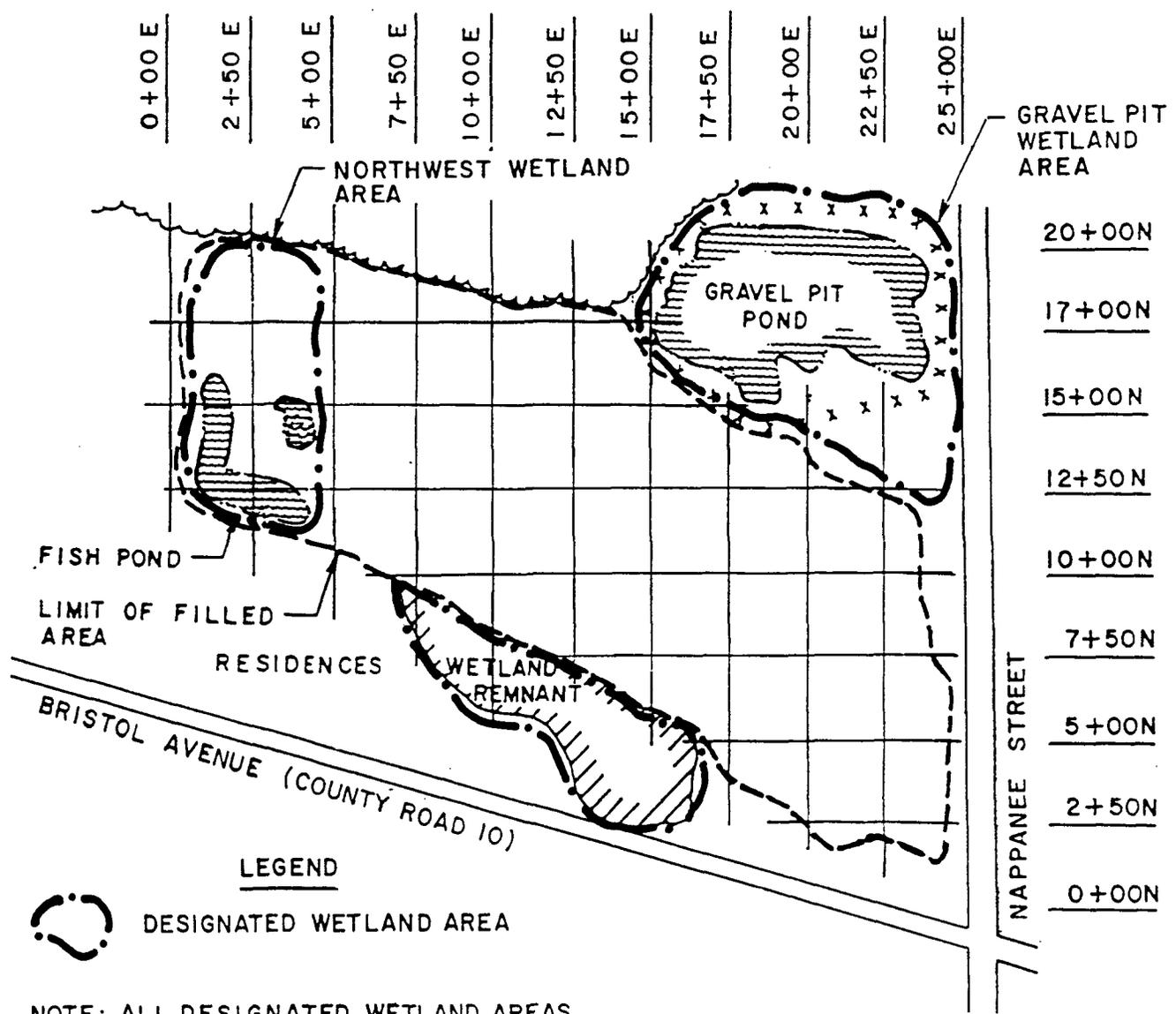
A wetland assessment and delineation shall be conducted to determine the extent, type, and quality of the wetland area. Three parameters are used to identify wetland areas; hydrophytic vegetation, hydric soils, and wetland hydrology. The parameters are evaluated using the mandatory technical criteria and field indicators outlined in the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation, 1989).

Chemical soil sampling of the three suspected wetland areas will occur in conjunction with the wetlands delineation. The three suspected wetland areas will be referred to as the Northwest Wetland Area, the Wetland Remnant, and the Gravel Pit Wetland Area. The location of these areas is presented in Figure 4-3.

4.6.2 Equipment

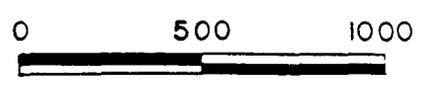
The equipment used during a wetland assessment and delineation includes:

1. Soil sampling tube
2. Dead blow hammer
3. Shovel
4. Site map
5. Field notebook
6. Munsell Color Book
7. Tape measure
8. Waders
9. Flagging tape and Wooden lathe
10. Compass
11. Camera
12. County soil survey
13. County hydric soils list
14. Hydric Soils of the United States
15. Hand Lens
16. Plastic bags
17. Field Guides for Plant Identification
18. U.S.G.S. topographic maps



LEGEND
 DESIGNATED WETLAND AREA

NOTE: ALL DESIGNATED WETLAND AREAS ARE APPROXIMATE



SCALE: FEET
 SCALE IS APPROXIMATE

SOURCE: US EPA, AUGUST 1986

Donohue

WETLANDS SAMPLING AREA



20026
 MAY, 1990

FIELD SAMPLING PLAN
 HIMCO DUMP SITE
 ELKHART, INDIANA

FIGURE 4-3

19. Aerial Photographs
20. Wetland Inventory Maps
21. Calculator
22. Stainless steel bown and spoon

4.6.3 Wetlands Delineation Procedures

The wetland assessment and delineation includes data collection and a field investigation. The data collection phase involves collecting maps, books and articles pertinent to the three wetland parameters. Sources include the following:

1. 7.5 minute U.S.G.S. topographic maps.
2. Large scale site maps.
3. National and State Wetland Inventory maps.
4. Flood information from Flood Insurance Rate Maps (FIRM) and Federal Emergency Management Agency (FEMA) maps .
5. Aerial photographs.
6. County soil survey.
7. Hydric Soils of the United States.
8. County hydric soils lists.
9. Federal Manual for Identifying and Delineating Jurisdictional Wetlands.
10. Library search of existing reports including environmental impact statements, wetland studies, vegetation studies, and local and regional groundwater reports.

The field investigation involves a site walkover to broadly characterize the hydrophytic vegetation and to focus the hydric soils-wetland hydrology study. During the walkover, field indicators and open water or saturated areas are noted. After the walkover, a sampling tube is used at chosen locations to examine the hydric soil and wetland hydrology. If a hydric soil is identified, the next soil cores are taken up-slope until a nonhydric soil is encountered. If the wetland hydrology is not present as a surface water feature, the wetland hydrology is noted in each soil core. To determine the wetland hydrology, the time of year, the relative amount of precipitation, and the period since the last precipitation event need to be taken into account when examining the water table level.

Concurrently with the hydric soil-wetland hydrology soil cores, the hydrophytic vegetation is examined in greater detail. The vegetation will be roughly mapped in relation to the soil cores.

The extent of the wetland will be mapped on the site map. The type and quality of the wetland will be derived from the hydrophytic vegetation, hydric soils and wetland hydrology.

4.6.4 Wetlands Soil Sampling Procedures

Sixteen soil samples will be collected from the three wetland areas - six from the Northwest Wetland Area, four from the Wetland Remnant, and six from the Gravel Pit Wetland Area (Figure 4-3). Biased samples will be selected from the worst areas within each location, including: wetland areas receiving drainage from the landfill cover, wetland areas adjacent to leachate seeps, and areas of apparent stressed vegetation. Soil samples will be composited from each sampling location in depths ranging from 0 to 18 inches.

Upon reaching a sample location vegetation which hinders the collection of samples will be cut away using small glass clippers. Each soil sample will be collected with the soil sampling tube. Grab samples for volatile organic analysis will be collected immediately by filling two 120 ml vials with no head space. Additional soil will then be placed in a stainless steel bowl. Each sample will be classified (USGS) and examined for obvious signs of contamination. This information will be recorded on a Soils Data Form. A stainless steel spoon will be used to stir the soil until a homogeneous mixture is obtained. The soil mixture will be divided into quadrants and small samples will be taken from each quadrant and placed in appropriate sample jars. The containers and sample volumes required are listed in Table 4-2.

4.6.5 Decontamination

The sampling tube will be decontaminated between sampling points using a Liquinox and tap water wash, an isopropanol rinse, and two deionized water rinses. Decontamination rinses containing isopropanol will be containerized for eventual discharge to the municipal wastewater treatment system.

4.6.6 Quality Control

The Site Manager and Quality Control Auditor will perform one field audit. Field documentation will undergo an internal QC review after the completion of field activities. Original field forms will be reviewed by the SQCO who will review the field forms for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

4.6.7 Documentation

Data collected and observations made during the wetlands assessment and delineation will be recorded in a field notebook and on the following field documentation forms (Appendix A):

1. Daily Time Log
2. Sample Collection Form
3. Photographs of Sampling Locations

4.7 SURFACE WATER AND SEDIMENT SAMPLING

4.7.1 Introduction

Surface water and sediment samples will be taken from the gravel pit pond and the two ponds in the southwest corner of the site. Four surface water and four sediment sample will be taken from each site.

4.7.2 Equipment

The following equipment will be used for surface water and sediment sampling:

1. Body harness
2. Hip waders
3. Rope
4. Stainless steel bowl and scoop
5. Stainless steel buckets
6. Brushes
7. Plastic bags
8. Soap
9. Isopropanol(A.C.S.)
10. Water, distilled and tap
11. Fiberglass tape
12. Field notebook
13. Liquinox

4.7.3 Sampling Procedures

4.7.3.1 Surface Water

The location of the sample will be described in the field notebook and a photograph will be taken if it aids in the identification of the sampling location. Water will be collected by lowering the sample bottles below the water surface. At all sampling locations, the water sample will be collected before the sediment sample. The analytes and sample bottles used are presented in Tables 4-1 and 4-2, respectively.

4.7.3.2 Sediment

The location of the sediment sample will be the same as the surface water location. The sediment sample will be obtained from the shore or near shore by a staff member wearing a body harness and an attached rope. The rope will be secured by a second staff person. The sample shall be collected using the stainless steel bucket and scoop. Sediment samples from the stainless steel bucket will then be placed in the stainless steel bowl after pouring off the excess water, broken up, and mixed using a large stainless steel scoop. The resultant mixed sediment will be spread evenly in the bottom of the bowl. The sediment will then be divided into four quadrants and a small sample will be taken from each quadrant; this sample will be sent for laboratory analysis. Sediment samples collected for VOCs will not be mixed in the bowl but taken

directly from the stainless steel bucket. The analytes and sample bottles used are presented in Tables 4-1 and 4-2, respectively. For all sampling locations, visual and olfactory observations of conditions of the sediments will be recorded in the field notebook.

Field duplicates will be collected at two locations by filling four 120 ml vials with sediment directly from the bucket. Remaining sediment will be mixed as indicated above, and four 8-ounce jars filled. Two 120 ml vials and two 8-ounce jars will be labeled as "FD".

4.7.4 Decontamination

The stainless steel bucket and stainless steel bowls and spoons will be cleaned between sample collection in the following manner: 1) Liquinox and water wash, 2) tap water rinse, 3) isopropanol rinse, and 4) two deionized water rinses. Decontamination rinses containing isopropanol will be containerized for eventual discharge to the municipal wastewater treatment system.

4.7.5 Quality Control

Field documentation will undergo an internal QC review after the completion of field activities. Original field forms will be reviewed by the SQCO who will review the field forms for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

4.7.6 Documentation

Data collected and observations made during surface water and sediment sampling will be recorded on the following field documentation forms (Appendix A):

1. Daily time log.
2. Sample collection form.
3. Photographs of sampling locations.

4.8 RESIDENTIAL GAS SAMPLING

4.8.1 Introduction

The basements of the six homes immediately south of the landfill on County Road 10 will be screened for the presence of landfill gases. This will be done to evaluate if any landfill gas has migrated off-site and if so, to see if it has impacted these nearby residents. This screening will be of a qualitative nature, and will check for the following compounds: methane and hydrogen sulfide. At this time, no data exists for the air quality in the basements of these homes.

4.8.2 Equipment

1. Lumidor Gasponder IV Model PGM-14 (for methane and hydrogen sulfide)
2. Field notebook
3. Camera and film
4. Thermometer
5. 3x5 index cards

4.8.3 Sampling Procedures

Once inside the basement of the home, the sampler should check for prominent cracks in the building foundation and floor drains or sumps. These areas will likely have the highest concentrations of hydrogen sulfide and methane, if present at all. Once up to two areas have been selected in the basement, the Lumidor should be started and the following parameters recorded on the Field Atmospheric Monitoring Log: sampling location, date, time, ambient temperature, barometric pressure, and relative humidity. After the Lumidor has been allowed to equilibrate (approximately 5 to 10 minutes) the concentrations of methane and hydrogen sulfide should be recorded. A photograph of the area, including a 3x5 index card with the house address prominently displayed, should be taken.

4.8.4 Decontamination

No decontamination is required.

4.8.5 Quality Control

Field documentation logs will undergo an internal QC review after the completion of field activities. Original field data will be reviewed for completeness, accuracy, and compliance with the FSP by the SQCO. Original field data will be stored on-site until completion of the field program at which time all documentation will be relinquished to the Site Manager.

4.8.6 Documentation

Data collected and observations made during the residential air sampling will be recorded in a field notebook and on the following field documentation forms (Appendix A):

1. Field Atmospheric Monitoring Log
2. Daily Time Log
3. Photographs of Sampling Locations

4.9 TEST PITS

4.9.1 Introduction

A magnetometer survey of the site will be conducted across the landfilled area (Section 4.5). In the event that anomalies are discovered by the magnetometer survey, test pits will be excavated to further investigate these areas. A maximum of 20 test pits will be excavated with a backhoe by the Subcontractor to study the anomalies. The purpose of the test pits will be to identify any areas where drum disposal may have occurred in the past. Sampling will not be required during this phase, but the identification of buried drums will be reported to the Site Manager immediately.

4.9.2 Equipment

1. A backhoe capable of reaching depths of 15 feet below ground surface
2. Fiberglass tape (0.01-foot increments)
3. Camera and film
4. Test pit logs and field forms
5. Field notebook
6. PPE as described in the HASP

4.9.3 Procedures

The test pit locations will be determined in the field by the geophysist and Field Manager. As the excavation advances, the Donohue field person responsible for logging the pit will describe the types of waste and soil being excavated and photograph any significant objects or staining. Upon completion of the pit (to a maximum depth of 15 feet), the fiberglass tape will be used to measure the total depth as well as any significant waste or soil horizons. This information will be recorded on the Test Pit Log forms. In the event that drums are discovered, excavation will stop and the Field Manager and Site Manager will be notified immediately and the excavation shall be backfilled with excavated material.

The location of all test pits will be documented and tied into the previously established cap grid coordinates. After backfilling, the pit locations will be further identified with a wooden lath and flagging.

4.9.4 Decontamination

Upon mobilization to the site, in between test pits, and upon demobilization from the site, the backhoe will be decontaminated to minimize the potential for cross contamination. The subcontractor will supply all equipment necessary to steam clean the backhoe and construct a temporary decontamination pad. The decontamination procedure will involve steam cleaning the backhoe in a predetermined location away from any groundwater monitoring wells.

4.9.5 Quality Control

Field documentation will undergo an internal QC review of the completion of field activities. Original field forms will be reviewed by the SQCO for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

4.9.6 Documentation

Test pit observations made by the on-site geologist during excavation activities will be recorded on the appropriate field forms shown in Appendix A. This will include:

1. Daily Time Logs
2. Test Pit Logs
3. Atmospheric Monitoring Logs
4. Photographs and descriptions

4.10 LEACHATE SEEPS

4.10.1 Introduction

No leachate collection system is present to sample. Therefore, if active seeps are noted during the RI field activities, they will be sampled to characterize the leachate quality.

A maximum of four locations will be sampled and analyzed for the same list of analytes proposed for groundwater.

4.10.2 Equipment

The equipment to be used for leachate sampling consists of:

1. Shovel
2. PPE as described in the HASP
3. Field notebook
4. Camera and film
5. Sample bottles and preservatives as listed in Table 4-2
6. Conductivity meter - yellow springs or equivalent
7. pH meter and pH 4, 7 and 10 calibration buffer solutions
8. Tap water, deionized water, and A.C.S. isopropanol
9. Five-gallon pail with cover for collecting and storing isopropanol rinses
10. Liquinox detergent
11. pH paper
12. Coolers
13. "Blue" ice or equivalent

14. EPA Region V sample tags and SMO traffic report labels
15. Millipore field filtration apparatus
16. 0.45 micron filters
17. Nitrogen gas cylinder and regulator for filtration apparatus

4.10.3 Procedures

The sampling locations will be selected in the field by the Field Manager based on where active flowing seeps are noted. A sump approximately 3'x1'x1' deep will be dug at the seep location using a decontaminated shovel. The sump will be sampled after it is at least half full with leachate. Measurement of pH and conductivity will be done on the leachate contained in the sump prior to sample collection. Sample containers will be dipped into the leachate in the sump. Preservatives will be added to the leachate and the pH checked with pH paper. As leachate has a tendency to be alkaline, more acid than is listed in Table 4-2 may be required to attain pH values of less than 2. Addition of more preservative than that listed will be noted in the field notebook. Filtration of leachate using the Millipore system will be done for the sample to be analyzed for dissolved bromide. After sample collection is complete, the sump will be backfilled.

The location of the sump will be documented relative to the nearest surveyed grid point and a photograph taken of the initial seep and the dug sump.

4.10.4 Decontamination

The shovel will be cleaned between sample locations in the following manner: 1) Liquinox and water wash; 2) tap water rinse, 3) isopropanol rinse, and 4) two deionized water rinses. Decontamination rinses containing isopropanol will be containerized for eventual discharge to the municipal wastewater treatment system.

4.10.5 Quality Control

Field documentation will undergo an internal QC review after the completion of field activities. Original field forms will be reviewed by the SQCO who will review the field forms for completeness, accuracy, and compliance with the FSP and QAPP. Original field forms and photo documentation will be stored on-site until completion of the field program. Upon completion of the field program, all documentation will be relinquished to the Site Manager.

A field blank will be collected by pouring deionized water over the decontaminated shovel used for sampling into sample bottles for the same case lots used for leachate collection. Filtration of the field blank using the Millipore system will be done for the sample to be analyzed for dissolved bromide.

At one of the four leachate seep locations, a field duplicate will be collected in the same manner as the sample. A duplicate set of sample bottles will be filled by dipping the bottles directly into the leachate.

4.10.6 Documentation

Data collected and observations made during leachate sampling will be recorded on the following field documentation forms (Appendix A):

1. Daily Time Log
2. Field Meter Instrument Calibration Log (pH, conductivity)
3. Field notebook

5.0 SAMPLE IDENTIFICATION NUMBERS AND DOCUMENTATION

Each sample will be identified using the five identification systems described below. These numbers will be used to complete sample documentation required by EPA including: sample labels, sample tags, Organic Traffic Reports, Inorganic Traffic Reports, SAS Packing Lists, Chain of Custody Forms, and Central Regional Laboratory Sample Data Reports. Examples of this documentation are included in Appendix A. Documentation will be completed following guidelines provided in the "User's Guide to the Contract Laboratory Program" (USEPA, December 1988).

5.1 FIELD SAMPLE IDENTIFICATION NUMBER

Field sample numbers are specified in Section 4.0 on sample location maps and rationale tables. Field sample numbers comprise a two-place alpha-code denoting sample medium followed by a two-digit sample location code.

5.2 SAMPLE LOCATION IDENTIFIER

Sample location identifiers will be used on sample tags, Chain of Custody Forms, and Organic and Inorganic Traffic Reports. Sample Location Identifiers consist of the following components.

Project Identification Code

A two-letter designation will be used to identify the site where the sample was collected. The two-letter designation for the Himco Dump Site, Elkhart, Indiana, will be "HD."

Sample Matrix and Location Codes

Each sample will be identified by an alpha-code corresponding to the sample medium (or sample type), followed by a two-digit sample location number. The alpha-codes are as follows:

- FB - Field Blank Sample
- FD - Field Duplicate Sample
- MS - Matrix Spike/Matrix Spike Duplicate
- GS - Surficial (0 to 6 inches) Soil Sample
- SB - Subsurficial (to water table) Soil Sample
- GT - Soil Boring Samples
- WT - Observation Well Groundwater Sample
- PZ - Piezometer Well Groundwater Sample
- TB - Trip Blank Sample
- TT - Tenax or Tenax/Charcoal sorbent tube sample (Waste Mass Gas Sample)
- GE - Geotechnical soil sample
- RW - Residential Well Sample

SD - Sediment Sample
SS - Surface Water Sample
LE - Leachate Seep Sample

Field blank samples will have an identification code of FB followed by the appropriate alpha-code for the type of sample (for example, a sediment water field blank will be identified as "FBSD"). Similarly, field duplicate samples, matrix spike samples, and trip blank samples will have FD, MS, and TB followed by the appropriate alpha-code.

Sample Event Identifier

All samples will have a two-digit number as the last component of the Site-Specific Sample Numbering system. Field sampling events will be numbered consecutively, starting with 01.

Examples of Site-Specific Sample Numbers are as follows:

HD-WT103A-01 Himco Dump RI/FS, Water Table Well Sample No. 1 from Water Table Well 103A.
HD-SD02-01 Himco Dump RI/FS, Sediment Sample No. 1 from the No. 2 Location.
HD-FDP101B-01 Himco Dump RI/FS, Field Duplicate Sample No. 1 Collected from Piezometer 101B.

5.3 SAMPLE LABELS

Sample labels are adhesive with unique numbers printed on them. Three types of sample labels will be used for the Himco Dump Site. These labels and the samples they will be attached to are:

<u>Label Type</u>	<u>Samples</u>
Organic labels	TCL Volatile Organics TCL Base Neutral Acid Organics TCL PCB/Pesticides
Inorganic labels	TAL Metals TAL Cyanide
SAS labels	Grain size, Atterberg Limits Consolidation Triaxial Shear BOD, COD, TSS, TDS, CR, SO ₄ , NH ₃ , NO ₂ & NO ₃ , TKN, TP, Bromide, Alkalinity, sorbent tubes

EPA provides organic and inorganic labels and designates SAS numbers to be used.

5.4 SAMPLE TAGS

A completed tag will be attached to each sample container. Tags have pre-printed numbers which shall be written on Chain of Custody Forms.

5.5 CENTRAL REGIONAL LABORATORY SAMPLE NUMBER

Samples to be sent to all CLP laboratories shall carry the Central Regional Laboratory (CRL) Sample Number. This number will be recorded on the CRL sample data report.

The Himco Dump CRL Sample Number consists of nine alpha-numeric characters as follows:

The first six characters will remain constant for Himco Dump RI sampling:

- 90 Fiscal Year of 1990
- ZD Indicates sample sent by a specific contractor, ZD for Donohue & Associates, Inc.
- 01 Designated survey number; this is the first investigation conducted by EPA at the Himco Dump site.

The last three characters (YYY) will vary during the sampling survey as follows:

The character "X" is a single-digit alpha-code designating the type of sample:

- S Sample
- D Duplicate Sample
- R Blank Sample

The character "YY" is a two-digit number designating the sample number. "YY" is used to consecutively number samples taken during this survey. For D-type (duplicate) samples, "YY" is the same as the sample number of which it is a duplicate. For R-type (blank) samples, "YY" is the consecutive number of blank samples taken during this survey.

Examples of CRL Sample Numbers:

- 90ZD01S01 Sample No. 01 of survey 01 in FY 90.
- 90ZD01D02 Duplicate Sample of Sample No. S02.
- 90ZD01R01 Blank Sample No. 01.

6.0 CHAIN OF CUSTODY

Upon collection of samples, a Chain of Custody form will be filled out in triplicate. When transferring the possession of samples, the individuals relinquishing and receiving shall sign, date, and note the time on the Chain of Custody form. The original custody form will be taped to the inside lid of the shipping cooler, and the pink and yellow copies will be maintained in the field project files. The shipping cooler will be secured with strapping tape. Two Region V custody seals, signed and dated by the FDC, will be placed across the front right and back left of the cooler. These custody seals will have unique numbers preprinted on them. The numbers should be recorded on the custody form before sealing the cooler. More detailed descriptions of Chain of Custody procedures are included in the following section and in Section 7.0 of the QAPP.

7.0 PACKAGING AND SHIPPING

7.1 PACKAGING REQUIREMENTS

Samples processed through the CLP will be packaged for shipment in compliance with current U.S. Department of Transportation (DOT) and commercial carrier regulations. All required government and commercial carrier shipping papers will be filled out and shipment classifications made according to current DOT regulations. Packaging of samples will be accomplished as follows.

An adhesive sample label and completed tag will be attached to each sample container. Sample labels will be covered with 3-inch wide clear tape. Tag wires will be taped to containers (except volatile vials) with fiber strapping tape. Each container will be placed in an appropriately sized zip-loc or polyethylene bag and sealed. Bagged samples will be placed in foam shipping sleeves or wrapped with bubble wrap.

An appropriately sized metal or plastic cooler will be selected, and drain plugs will be taped on the inside and outside with duct tape. The cooler will be lined with a large polyethylene garbage bag. Samples (in sleeves or bubble wrap) will be placed in the large polyethylene garbage bag. Absorbent packing material (styrofoam or vermiculite) will be placed under and around samples (in sleeves or bubble wrap) to minimize the possibility of breakage.

Completed Traffic Reports, SAS Packing Lists, Chain of Custody Forms, and completed return address labels will be inserted in a zip-loc bag and taped to the underside of the cooler lid. The large polyethylene garbage bag will be sealed, and blue ice or ice packs will be placed on top of the sealed bag. Ice will be enclosed in sealed plastic bags to prevent soaking of packing materials.

The closed cooler will be taped with duct tape in at least two locations. Chain of Custody Seals, with serial numbers previously recorded on the Chain of Custody Form in the cooler, will be placed over cooler latches or at the cooler left back and right front corners, so that seals will break if the cooler is opened. Seals will be covered with clear tape.

A label marked "Environmental Samples" will be placed on top of the cooler and covered with clear tape. Appropriate sides of the cooler will be marked "This End Up" and arrows will be added accordingly.

Coolers will be weighed and air bills filled out. All samples will be shipped through a reliable commercial carrier, such as Federal Express, Emery, Puro-lator, or equivalent.

7.2 SHIPMENT COORDINATION

The Donohue FDC will notify the EPA Sample Management Office (SMO) of all sample shipments on the day of shipment. At that time, Donohue will provide the following information:

1. FTL name and site office telephone number.
2. Case number and/or SAS number of the project.
3. Site name/code.
4. Exact number(s), matrix(ces), and level(s) of samples.
5. Laboratory(ies) samples were shipped to.
6. Carrier name and airbill number(s) for the shipment.
7. Method of shipment (i.e., overnight, 2-day).
8. Date of shipment.
9. Suspected hazards associated with the samples or site.
10. Any irregularities or anticipated problems with the samples, including special handling instruction or deviations from established sampling procedures or numbers of samples.
11. Status of the sampling project (i.e., final shipment, update of future shipping schedule).

Sample shipments made after 5:00 p.m. EST, will be called in to the SMO at the start of business the next day (8:00 a.m. EST). The SMO will be notified by 3:00 p.m. EST Friday concerning information on sample shipments going out Friday intended for Saturday delivery/pickup.

ARCS/P/HIMCO/AC5

APPENDIX A
FIELD DOCUMENTATION FORMS

Donohue

Soils Data Form

Soil Sample Area _____

Soil Subsample _____

Engineers & Architects & Scientists

Site _____ Project No. _____

DATE _____

FIELD SCREENING DATA

TIME _____

METHANE (as % $le\frac{1}{2}$) _____

COLLECTOR _____

HYDROGEN SULFIDE (ppm) _____

RADIOACTIVITY (counts per minute) _____

SAMPLE DEPTH _____

(TOTAL ALPHA, BETA, & GAMMA cpm)

PHYSICAL DESCRIPTION OF SUBSAMPLING LOCATION: _____

DESCRIPTION OF SUBSAMPLE: _____

ANY OTHER CHARACTERISTICS OF NOTE: _____

DAILY TIME LOG

DONOEUE & ASSOCIATES, INC. CLIENT _____ DATE _____

CONSULTING ENGINEERS PROJECT _____ BY _____

SEEBOYGAN, WISCONSIN PROJECT NO. _____ PAGE NO. _____

Weather: A.M. _____
P.M. _____

Temp. Range Hi _____ Low _____ Frost Depth _____

Equipment Used _____

Contractor's Personnel _____ Ers _____

Donchue Observer(s) _____

Time Log indicating work in progress, remarks

7:00 - 7:30	_____
7:30 - 8:00	_____
8:00 - 8:30	_____
8:30 - 9:00	_____
9:00 - 9:30	_____
9:30 - 10:00	_____
10:00 - 10:30	_____
10:30 - 11:00	_____
11:00 - 11:30	_____
11:30 - 12:00	_____
12:00 - 12:30	_____
12:30 - 1:00	_____
1:00 - 1:30	_____
1:30 - 2:00	_____
2:00 - 2:30	_____
2:30 - 3:00	_____
3:00 - 3:30	_____
3:30 - 4:00	_____
4:00 - 4:30	_____
4:30 - 5:00	_____
5:00 - 5:30	_____
5:30 - 6:00	_____
6:00 - 6:30	_____

Items requiring follow-up:

cc: Visitors Representing

Donohue

Soils Data Form

Soil Sample Area _____

Soil Subsample _____

Engineers & Architects & Scientists

Site _____ Project No. _____

DATE _____

TIME _____

COLLECTOR _____

SAMPLE DEPTH _____

PHYSICAL DESCRIPTION OF SUBSAMPLING LOCATION: _____

DESCRIPTION OF SUBSAMPLE: _____

ANY OTHER CHARACTERISTICS OF NOTE: _____

Map Key Letter	Tax Key Number	Property Owner & Address
A	25-300-001	Miles, Inc. 1127 Myrtle St Elkhart, Indiana 46514
B	36-126-001	CLD Corp 1126 Johnson St Elkhart, Indiana 46514
C	36-226-001	Miles, Inc. 1127 Myrtle St Elkhart, Indiana 46514
	36-251-017	Richard L. Bauer 28399 CR 10 Elkhart, Indiana 46514
D	36-276-001	Alonzo Craft, Jr. PO Box 1637 Elkhart, Indiana 46515
F	003	Alonzo Craft, Jr. PO Box 1637 Elkhart, Indiana 46515
G	004	Indiana & Michigan Power Co. 201 S. 2nd St Elkhart, Indiana 46516
H	006	City of Elkhart
I	36-226-002	City of Elkhart
J	36-201-001	CLD Corp 1126 Johnson St Elkhart, Indiana 46514
K	36-251-001	CLD Corp 1126 Johnson St Elkhart, Indiana 46514
L	004	Harman & Paul 28369 CR 10 Elkhart, Indiana 46514
M	005	James A. ... 28343 CR 10 Elkhart, Indiana 46514
	008	Heier, ... 18213 CR 10 Elkhart, Indiana 46514
O	006	Jerry S. ... 2441 Harvey Elkhart, Indiana 46514
P	009	... 28119 CR 10 Elkhart, Indiana 46514

Map Key Letter	Tax Key Number	Property Owner & Address
Q	36-251-013	Alonzo Craft, Jr. PO Box 1687 Elkhart, Indiana 46515
R	014	Noble & Selmer 28279 CR 19 West Elkhart, Indiana 46514
S	015	Alonzo Craft, Jr. PO Box 1687 Elkhart, Indiana 46515
T	016	NOble & SELmer 28279 CR 19 West Elkhart, Indiana 46514
U	018	CLD Corp. 1126 Johnson St. Elkhart, Indiana 46514
V	36-252-001	Architectural Corp. of America 717 Randolph St. Elkhart, Indiana 46514
W	002	Architectural Corp. of America 717 Randolph St. Elkhart, Indiana 46514
X	003	Albert M. Morris 28330 CR 19 West Elkhart, Indiana 46514
Y	36-426-002	Miles, Inc. 1127 Myrtle St. Elkhart, Indiana 46514
Z	36-277-002 -001	Miles, Inc. 1127 Myrtle St. Elkhart, Indiana 46514
AA	36-251-010	Selmer Brown 28279 CR 19 West Elkhart, Indiana 46514
BB	36-126-002	Richard E. Martin, Sr. & P 28597 CR 10 Elkhart, Indiana 46514
CC	36-401-001 -002 -003	Elkhart Community School 2726 Calhoun St. Elkhart, Indiana 46514

P. 4-13 to 4-14 CHANGE

2nd paragraph. Delete From "Two samples at each well nest" to "encrustation of grains, additional samples may be taken."

Insert

→ During the installation of the ten new monitoring wells, a maximum of 86 possible soil samples could be obtained by collecting a soil sample every five feet. Of the 86 soil samples collected 30 ~~will~~ will be selected for chemical analysis. Of the 30 samples collected for chemical analysis 14 will be collected at the well nests (7 per nest) and 16 will be collected at the un-nested locations (4 at each location). The 30 soil samples will be selected by the field geologist based upon visual inspection and field screening with a photoionization detector. ~~The~~ ~~samples will be selected~~ ~~selected~~ based every five feet, from five feet below the surface, to five feet below the water table. If the field geologist notes any unusual evidence of visual staining, zone of saturation, high HNu values, presence of clay and/or encrustation of grains, additional samples may be taken. ~~In~~ ~~add~~

In addition, ~~two~~ of the 86 soil samples collected two at each well nest location (4 total) will be sent to the laboratory for geotechnical testing; a sample of the fine-grained confining unit described in USG's report will be taken if encountered. Samples will be tested for grain size distribution by sieve or hydrometer methods. If applicable, up to three samples will also be tested for Atterberg Limits and laboratory permeability.

Monohue

DRILLING DATA

Engineers & Architects

ADDITIONAL DRILLING DATA

Bit Tube Size _____ ID _____ OD
 Hammer Wt. _____ lb _____ in drop
 Thin Wall Tube Size _____ OD
 Casing Used _____ LF _____ Dia.
 Casing Hammer _____ lb _____ in drop
 Drill Rod Size _____
 Drill Bit Type _____ (a) _____ (b)
 Drill Bit Size _____ (a) _____ (b)
 Auger Type _____ OD
 Hollow Stem Auger _____ ID
 Core Barrel Size _____ ID _____ Length
 Core Bit Serial _____
 Core Bit Serial _____
 Drill Mud Type _____
 Drill Mud Formula _____
 Depth Drill Mud Used _____
 Back Filled Date _____
 Method _____ by _____
 Drill Rig Mfg. Mod. _____
 Other Equip. _____
 Other Equip. _____

DRILLING INFORMATION

1. Record measurements in tenths of feet.
2. For samples, record sample type (soil, rock, core), depth, sample interval, length of sample recovered.
3. Record first encountered water and any other distinct water producing zones.
4. Record blow counts (penetration), hammer weight, length of fall for driven samples.
5. Record use of drilling fluid, fluid type, source of water, fluid losses, interval (top and type) where fluid loss occurred, if determinable, quantitative estimate of volume of fluid lost.
6. Record drilling equipment used and general drilling procedures.
7. Record all problems encountered during drilling.
8. Collect samples of backfill, grout, and concrete.
9. Report general drilling conditions: (temperature, raining, etc.)

Soil/Rock Description Requirements

1. Soil
 - a. Written classification
 - b. USCS symbol
 - c. Estimated % of secondary components % and size gravel, cobble
 - d. Color, moisture
 - e. Plasticity (general)
 - f. Consistency (plastic) or density (nonplastic)
 - g. Structure
 - h. Texture/fabric/bedding
 - i. Depositional environment
2. Rock
 - a. Classification
 - b. Lithologic characteristics
 - c. Bedding/banding
 - d. Color
 - e. Hardness
 - f. Degree of cementation
 - g. Texture
 - h. Structure
 - i. Degree of weathering
 - j. Solution or void conditions
 - k. Primary and secondary estimated hydraulic conductivity, resistance
 - l. Note natural and coring induced fractures, and text core including probable reason for. Include number of fractures per foot, number of fractures per total length of recovery.

Texture	Abbreviation	Size	Abbreviation	Soil Particle Size
Boulder	Bo			Over 3.0"
Gravel	Gr	Large	L	1.0" to 3.0"
		Medium	M	.38" to .88"
		Small	Sm	2.0mm to .38"
Sand	S	Coarse	Co	.75mm to 1.99mm
		Medium	M	.25mm to .74mm
		Fine	F	.05mm to .24mm
Silt	Si			.002mm to .049mm
Clay	C			Smaller than .002mm

Consistency	Abbreviation	N	Density	Abbreviation	N
Very Soft	VS	0-2	Very Loose	VL	0-4
Soft	S	3-4	Loose	L	5-9
Medium	M	5-8	Medium Dense	MD	10-29
Stiff	St	9-16	Dense	D	30-49
Very Stiff	VST	17-30	Very Dense	VD	50+
Hard	H	Over 30			

% of Dry Weight	Term	Abbreviation
0-10	Trace or Occasional	TR or OC
11-20	Little	LI
21-35	Some	SO
36-50	And or With	& or W/

CONDITIONS FOR USE OF SOIL BORING LOG

This field soil boring log records the soil descriptions and other data observed or measured in the field by qualified soil technicians. The soils between the samples may have been determined by the "feel" of the drill bit or wash cuttings. The changes between the soil strata may be transitional rather than abrupt, particularly with respect to color, weathering, and consistency changes. The amount of large sized gravel or

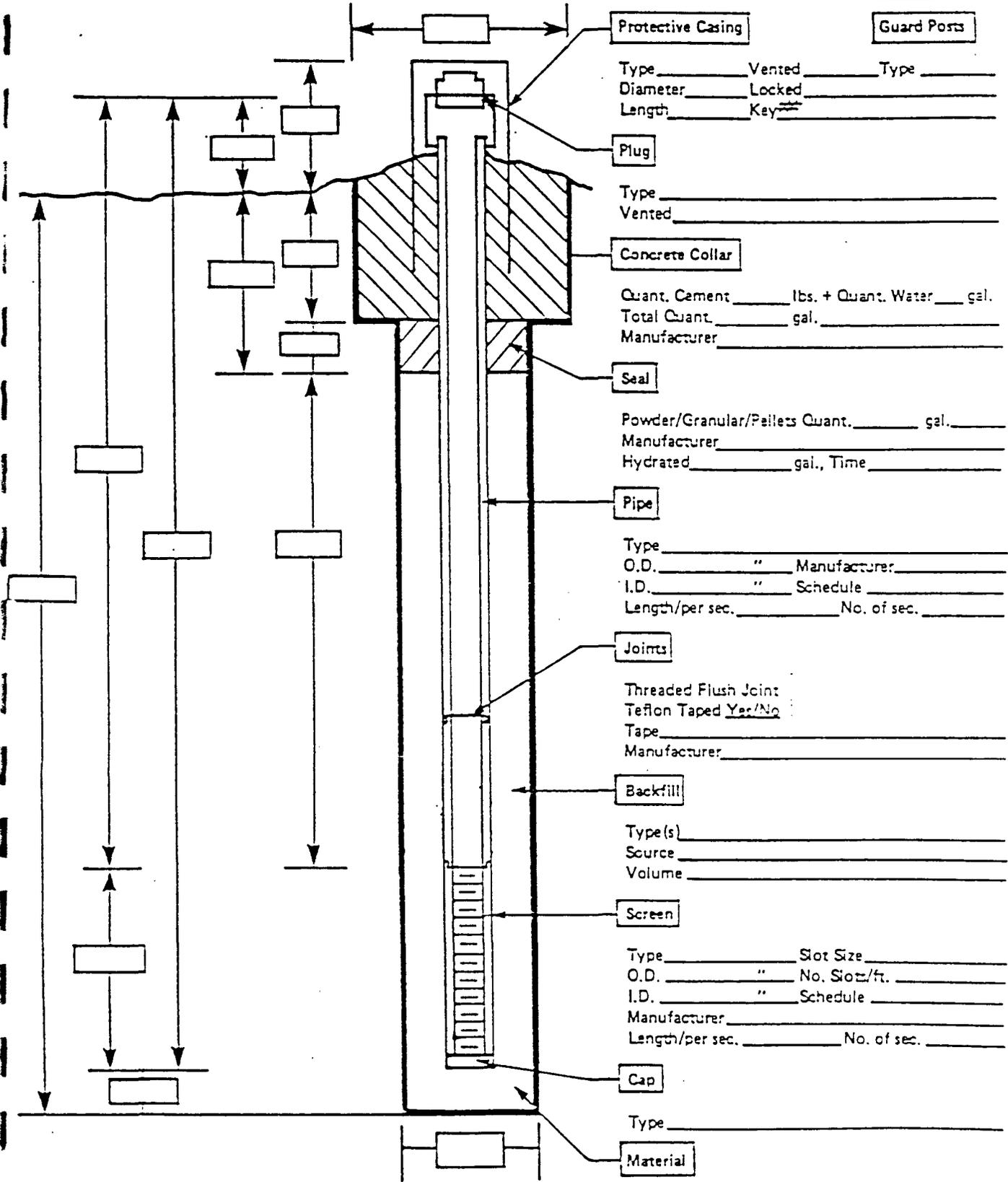
Donohue

OBSERVATION WELL INSTALLATION DIAGRAM

Well No. _____

Site: _____ Date: _____

By: _____ Project No. _____



Notes: Water Source _____

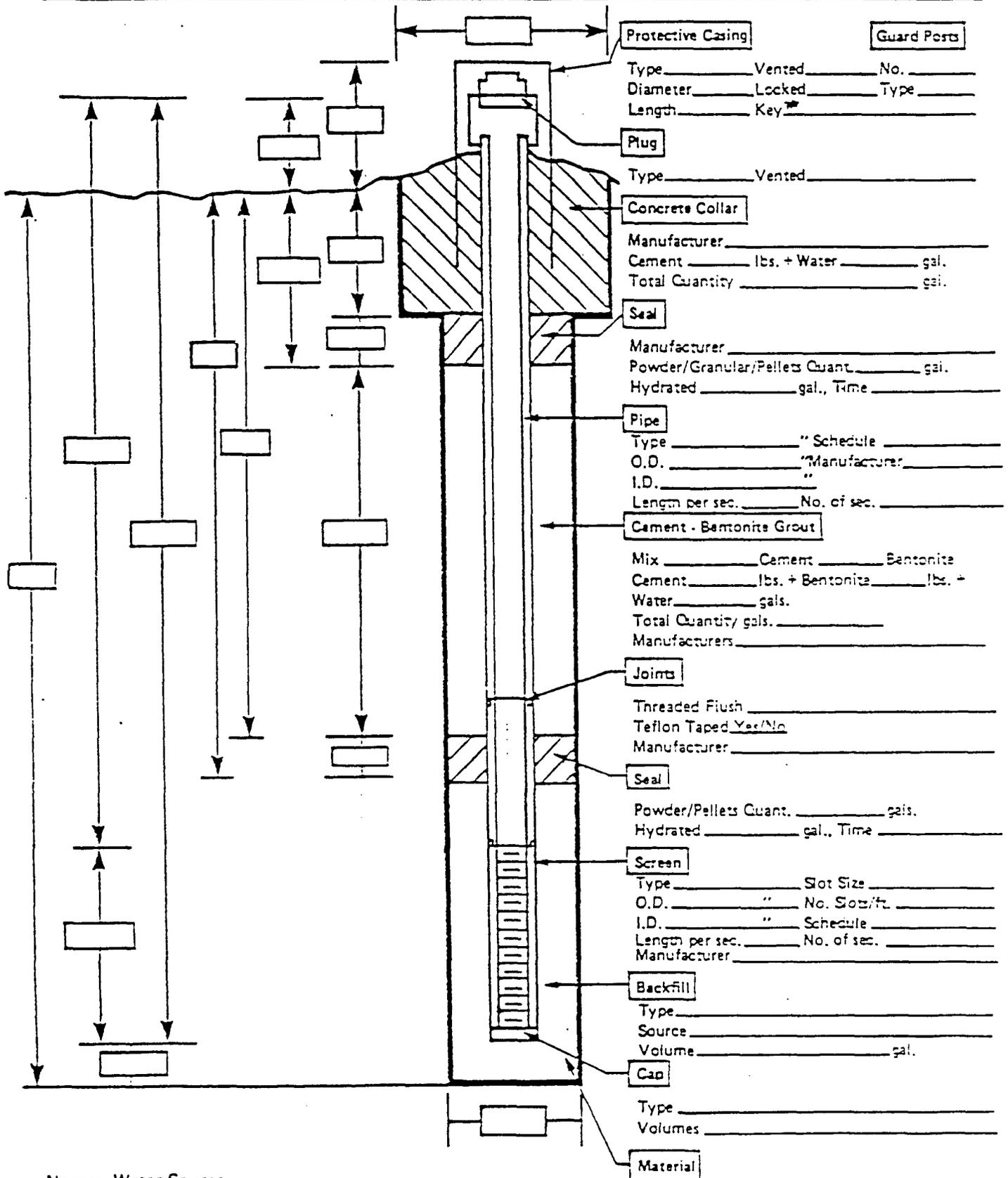
Donohue

PIEZOMETER INSTALLATION DIAGRAM

Well No. _____

Site: _____ Date: _____

By: _____ Project No. _____

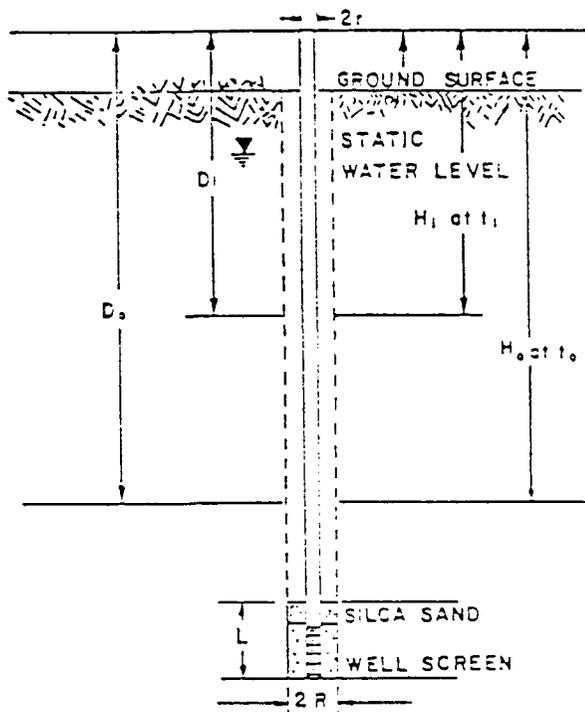


Notes: Water Source _____

INFIELD PERMEABILITY TEST

Project No. _____ Site _____

Client _____ Well Screened In _____ Diameter of Pipe (ft.) _____
 (formation) (2r)
 Well Drilled By _____ Static Water Level _____ Screen Length (ft.) _____
 (SWL)
 Date Test Performed _____ Diameter of Hole (ft.) _____ "L" Length (ft.) _____
 (2R) (note below)
 Top of Pipe Elevation _____ Vol. Removed _____ Depth to Top of Screen _____
 Estimated m = KH/KV



Hoover's Equation for Piezometer in Anisotropic Soil

$$K_f = \frac{r^2}{2L(t_2 - t_1)} \ln\left(\frac{2L}{R}\right) \ln\left(\frac{H_1}{H_2}\right) \quad (502)$$

= K_f cm/sec

READING	Time (min.)	DEPTH TO WATER (FT) AFTER BAILING D ₂	D ₁ SWL = D ₁ (ft.)	H ₁ / H ₂
t 0				
t 1				
t 2				
t 3				
t 4				
t 5				
t 6				
t 7				
t 8				
t 9				
t 10				
t 11				
t 12				
t 13				
t 14				
t 15				
t 16				
t 17				
t 18				
t 19				
t 20				
t 21				
t 22				
t 23				
t 24				

Notes: _____

Test Performed By _____ Date _____

Calculations By _____ Date _____

Sample Logbook Format

(Bound notebook, with sequential pages)

ITR No.	GTR No.	CRL Sample Number	Site Specific Sample Number IIO	Collection Info				Analytes		SAS	SIS	Shipment Info			Comments
				Depth	Date	Time	Wind	SAS Metals CN	SAS EXT./FOA			Date Sent	Lab	Airbill #	
								TCL VOA TCL BNA TCL PCB/P TCL Metals/CN SAS Water Qual SAS Bromide SAS Geotech SAS Tubes SAS Res. well							

Recorded by _____
 QC'd by _____

Staff Gauge Information Form

Donohue
Engineers, Architects & Scientists

Site: _____ Date: _____
By: _____ Project No.: _____

Staff Gauge No. _____

Location: _____

Top of Pipe Elevation: _____

Date/Time: _____ Water Level: _____

Comments: _____

Staff Gauge No. _____

Location: _____

Top of Pipe Elevation: _____

Date/Time: _____ Water Level: _____

Comments: _____

Staff Gauge No. _____

Location: _____

Top of Pipe Elevation: _____

Date/Time: _____ Water Level: _____

Comments: _____

Staff Gauge No. _____

Location: _____

Top of Pipe Elevation: _____

Date/Time: _____ Water Level: _____

Comments: _____

Project Code	Station No.	Month/Day/Year	Time	Designate			
				Comp.	Grab		
Station Location		Samplers (Signatures)					
Tag No.						Preservative:	
5-181860						Yes <input type="checkbox"/> No <input type="checkbox"/>	
Lab Sample No.						ANALYSES	
						BOD Anions	
						Solids (TSS) (TDS) (SS)	
						COD, TOC, Nutrients	
						Phenolics	
						Mercury	
						Metals	
						Cyanide	
						Oil and Grease	
		Organics GC/MS					
		Priority Pollutants					
		Volatile Organics					
		Pesticides					
		Mutagenicity					
		Bacteriology					
Remarks.							

U.S. ENVIRONMENTAL PROTECTION AGENCY
 REGION V
 OFFICIAL SEAL
 No 97013

EFY	83	- Extractable	MEFK	04	- Total Metals
EFY	83	- Extractable	MEFK	04	- Total Metals
EFY	83	- Extractable	MEFK	04	- Cyanide
EFY	83	- Extractable	MEFK	04	- Cyanide
EFY	83	- VOA	MEFK	04	
EFY	83	- VOA	MEFK	04	
EFY	83		MEFK	04	
EFY	83		MEFK	04	
EFY	83		MEFK	04	
EFY	83		MEFK	04	

U.S. ENVIRONMENTAL PROTECTION AGENCY
 CLP Sample Management Office
 P.O. Box 813 - Alexandria, Virginia 22313
 Phone: 703/557-2490 - FTS/557-2490

SAS Number

SPECIAL ANALYTICAL SERVICE
 PACKING LIST

Sampling Office: _____	Sampling Date(s): _____	Ship To: _____	For Lab Use Only
Sampling Contact: _____	Date Shipped: _____		Date Samples Rec'd: _____
(name) _____	Site Name/Code: _____	Attn: _____	Received By: _____
(phone) _____			

Sample Numbers	Sample Description i.e., Analysis, Matrix, Concentration	Sample Condition on Receipt at Lab
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____
11. _____	_____	_____
12. _____	_____	_____
13. _____	_____	_____
14. _____	_____	_____
15. _____	_____	_____
16. _____	_____	_____
17. _____	_____	_____
18. _____	_____	_____
19. _____	_____	_____
20. _____	_____	_____

For Lab Use Only

White - SMO Copy, Yellow - Region Copy, Pink - Lab Copy for return to SMC, Gold - Lab Copy

APPENDIX B
SCHEMATIC DIAGRAMS

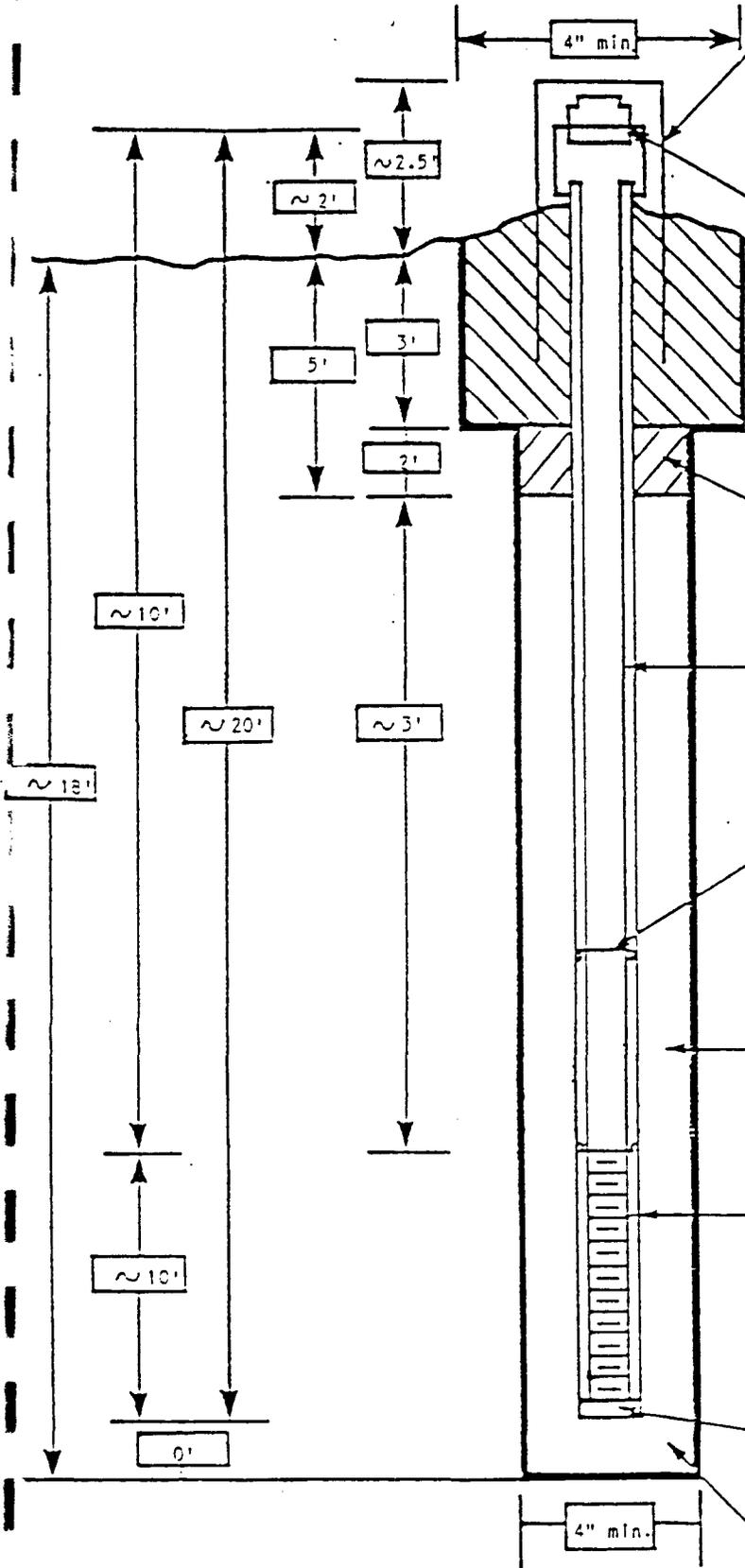


OBSERVATION WELL INSTALLATION DIAGRAM

Well No. _____

Site: Himco Dump Date: _____

By: _____ Project No. _____



Protective Casing **Guard Posts**

Type Steel Vented Yes Type _____
 Diameter 4" Locked Yes
 Length 5' Key Keved Alike

Plug

Type PVC - Threaded
 Vented Yes

Concrete Collar

Quant. Cement _____ lbs. + Quant. Water _____ gal.
 Total Quant. _____ gal.
 Manufacturer _____

Seal

Powder/Granular/Pellets Quant. _____ gal.
 Manufacturer _____
 Hydrated _____ gal., Time _____

Pipe

Type PVC
 O.D. _____ " Manufacturer _____
 I.D. 2 " Schedule 40
 Length/per sec. _____ No. of sec. _____

Joints

Threaded Flush Joint
 Teflon Taped Yes/No
 Tape _____
 Manufacturer _____

Backfill

Type(s) No. 50 Sand
 Source _____
 Volume _____

Screen

Type PVC Slot Size No. 10
 O.D. _____ " No. Slots/ft. _____
 I.D. 2 " Schedule _____
 Manufacturer _____
 Length/per sec. _____ No. of sec. _____

Cap

Type PVC - Threaded

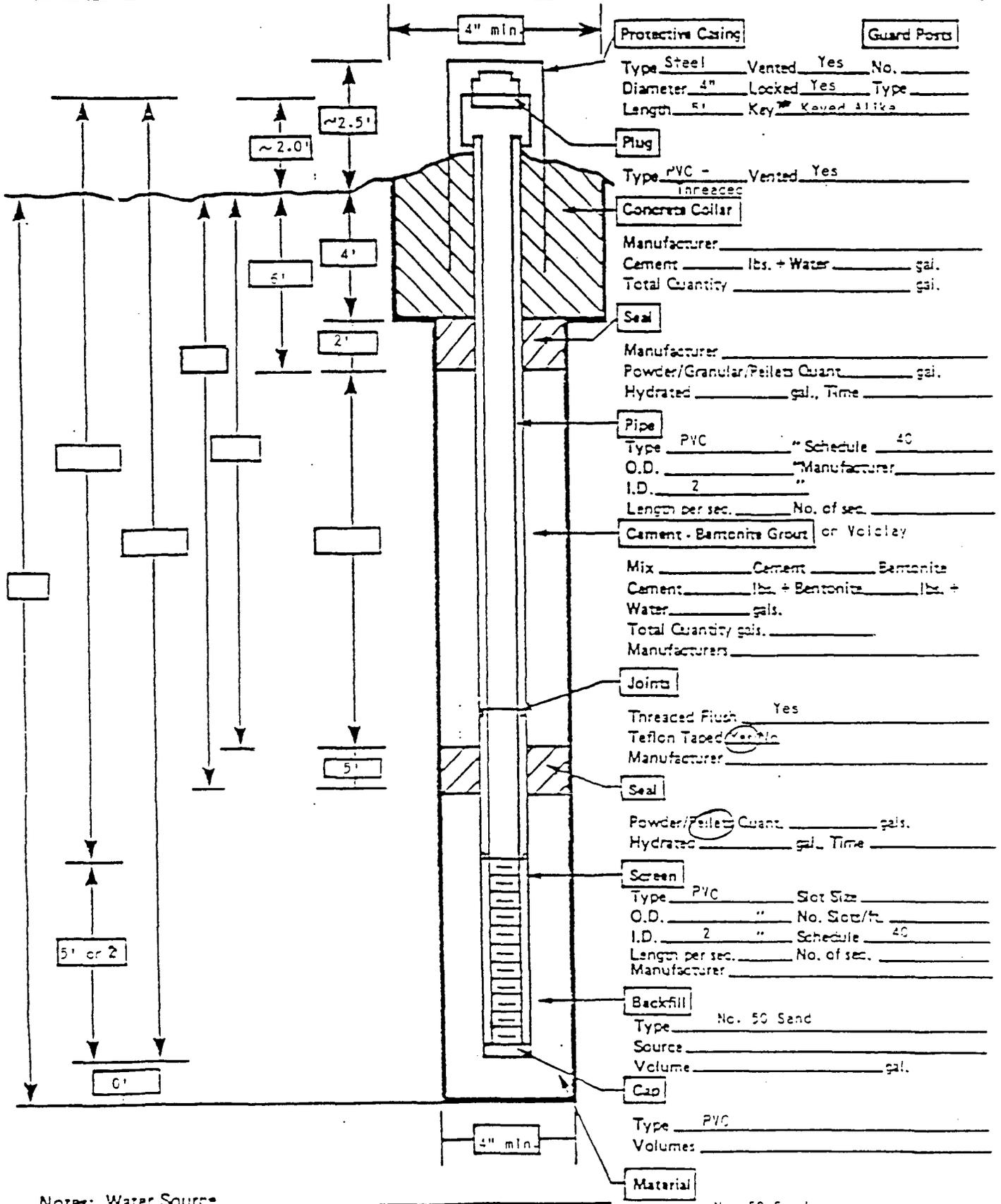
Material

No. 50 Sand

Notes: Water Source _____

Site: Himco Dump Date: _____

By: _____ Project No. _____



Protective Casing **Guard Post**

Type Steel Vented Yes No. _____
 Diameter 4" Locked Yes Type _____
 Length 5' Key Keyed alike

Plug

Type PVC - threaded Vented Yes

Concrete Collar

Manufacturer: _____
 Cement _____ lbs. + Water _____ gal.
 Total Quantity _____ gal.

Seal

Manufacturer: _____
 Powder/Granular/Pellets Quant. _____ gal.
 Hydrated _____ gal., Time _____

Pipe

Type PVC " Schedule 40
 O.D. _____ " Manufacturer: _____
 I.D. 2 "
 Length per sec. _____ No. of sec. _____

Cement - Bentonite Grout or Void clay

Mix _____ Cement _____ Bentonite _____
 Cement _____ lbs. + Bentonite _____ lbs. +
 Water _____ gals.
 Total Quantity gals. _____
 Manufacturer: _____

Joints

Threaded Flush Yes
 Teflon Taped No
 Manufacturer: _____

Seal

Powder/Pellets Quant. _____ gals.
 Hydrated _____ gal., Time _____

Screen

Type PVC Slot Size _____
 O.D. _____ " No. Slots/ft. _____
 I.D. 2 " Schedule 40
 Length per sec. _____ No. of sec. _____
 Manufacturer: _____

Backfill

Type No. 50 Sand
 Source: _____
 Volume _____ gal.

Cap

Type PVC
 Volumes _____

Material

No. 50 Sand

Notes: Water Source _____

APPENDIX C

CALIBRATION AND OPERATING PROCEDURES
FOR FIELD INSTRUMENTS
AND FILTRATION UNIT

THERMOMETER

Measurement Techniques for Water Temperature

Temperature measurements should be taken in-situ, or as quickly as possible in the field. Collected water samples may rapidly equilibrate with the temperature of their surroundings.

If a thermometer is used on a collected water sample:

1. Rinse the thermometer with a portion of the collected sample.
2. Immerse the thermometer in the sample until temperature equilibrium is obtained (1-3 minutes). To avoid the possibility of contamination, the thermometer should not be inserted into samples which will undergo subsequent chemical analysis.
3. Record values on field forms.

If a temperature meter or probe is to be used, the instrument should be calibrated according to the manufacturer's recommendations and a National Bureau of Standards (NBS) certified thermometer or one that is traceable to NBS certification before field use. Cross-checks and duplicate field analyses should agree within ± 0.5 degrees C. A cross-check with a calibrated NBS certified thermometer shall be made at least semi-annually and within one week before use in the field.

Thermometers should also be checked against the NBS reference thermometer. Results of all calibration should be recorded on the Field Meter Log Sheet.

Source: Ebasco Rem III Program Guidelines No. FT-7.10.

SPECIFIC CONDUCTANCE

It is important to obtain a specific conductance measurement soon after taking a sample, since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect the specific conductance.

Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are listed below:

1. Check batteries and calibrate instrument before going into the field. Potassium chloride standard solutions with a specific conductance closest to the values expected in the field should be used. The table below may be used for guidance:

SPECIFIC CONDUCTANCE OF KCl SOLUTIONS AT 25 DEGREES CENTIGRADE

<u>Concentration</u>	<u>Specific</u>	<u>Conductance</u>
mol/l	mg/l	umhos/cm
0.0001	7.456	14.94
0.0005	37.28	73.90
0.001	74.56	147.0
0.005	372.8	717.8
0.00702	523.4	1000
0.01	745.6	1413
0.02	1591.2	2767

NOTE: This table has been modified from Standard Methods for the Examination of Water and Wastewater (1980).

2. Record the true and actual meter readings on the Field Meter Calibration Form.
3. Rinse the cell with one or more portions of the sample to be tested.
4. Immerse the electrode in the sample and measure the conductivity.
5. Read and record the results in a field log book. Adjust the temperature setting to the sample temperature.
6. Repeat the procedure with fresh sample until reproducible (+/-10%) results are obtained.

If the specific conductance measurements become erratic, or inspection shows that any platinum black has flaked off the electrode, replatinization of the electrode is necessary. See the manufacturer's instructions for details.

Source: Ebasco Rem III Program Guidelines No. FT-7.10.

pH METER

Two field methods are available for pH measurement: the pH meter and pH indicator paper. Indicator paper is used only when a rough estimate of the pH is required, for example to check proper acid/base preservation of samples. The pH meter is used when a more accurate measurement is needed. The response of a pH meter can be affected by high levels of colloidal or suspended solids, but the effect is usually small and generally of little significance. Consequently, specific methods to overcome this interference are not described. The response of pH paper is unaffected by solution interferences from color, turbidity, colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered. In such cases, use of a pH meter is recommended.

Equipment

The following equipment is needed for taking pH measurements:

1. Orion portable pH meter, or equivalent.
2. Combination electrode with polymer body to fit the above meter (alternately a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs).
3. pH indicator paper, such as Hydrion or Alkacid, to cover the pH range 2 through 12.
4. Buffer solutions of pH 4, 7 and 10, or other buffers which bracket the expected pH range.

Because of the diversity of pH meters currently available on the market, the investigator has the option of selecting the unit that best meets specific investigative needs and field limitations. Digital meters are preferred, as opposed to deflection meter outputs, because of the relative ease in reading response for in-situ measurements.

Measurement Techniques for Field Determination of pH

1. pH Meter

The following procedure is used for measuring pH with a pH meter:

- a. The instrument and batteries should be checked and calibrated in the laboratory before the field effort begins.
- b. The accuracy of the buffer solutions used for field and laboratory calibration should be checked. Buffer solutions need to be changed due to degradation upon exposure to the atmosphere.

(The date of preparation of each buffer should be included on the bottle label.) Record source of buffer and date opened on Field Meter Log Sheet.

- c. Immerse the tip of the electrodes in water overnight. If this is not possible due to field conditions, immerse the electrode tip in water for at least an hour before use. The electrode tip may be immersed in a rubber or plastic sack containing buffer solution for field transport or storage. This is not applicable for all electrodes, as some must be stored dry.
- d. Make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).
- e. Immerse the electrode(s) in a pH-7 buffer solution.
- f. Adjust the temperature compensator to the proper temperature (on modes with automatic temperature adjustment, immerse the temperature probe into the buffer solution). Alternately, the buffer solution may be immersed in the sample and allowed to reach temperature equilibrium before equipment calibration. It is best to maintain buffer solution at or near expected sample temperature before calibration.
- g. Adjust the pH meter to read 7.0.
- h. Remove the electrodes(s) from the buffer and rinse well with demineralized water. Immerse the electrode(s) in pH-4 or 10 buffer solution (depending on the expected pH of the sample) and adjust the slope control to read the appropriate pH. At least three successive readings during calibration, one minute apart, should be within ± 0.1 pH unit. For best results, the standardization and slope adjustments should be repeated at least once daily before use.
- i. Immerse the electrode(s) in the unknown solution, slowly stirring the probe until the pH stabilizes. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a chemical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. This must be clearly noted in the log book.
- j. Read and record the pH of the solution, after adjusting the temperature compensator to the sample temperature. pH should be recorded to the nearest 0.1 pH unit on the Field Meter Calibration Log.

k. Rinse the electrode(s) with demineralized water.

l. Keep the electrode(s) immersed in water when not in use.

The sample used for pH measurement should never be saved for subsequent conductivity or chemical analysis. All pH electrodes leak small quantities of electrolytes (e.g., sodium or potassium chloride) into the solution. Precipitation of saturated electrolyte solution, especially at colder temperatures, or in cold water, may result in slow electrode response. Any visual observation of conditions which may interfere with pH measurement, such as oily materials or turbidity, should be noted on the Field Meter Calibration Log.

Source: Ebasco Rem III Program Guidelines No. FT-7.10.

DISSOLVED OXYGEN METER

The YSI Model 57 dissolved oxygen meter will be calibrated every 8 hours using the air calibration procedure:

1. Place the probe in moist air. The probe can be placed in a partially filled (50 ml) BOD bottle or the small storage bottle (the one with the hole in the bottom) along with a few drops of water. The probe can also be wrapped loosely in a damp cloth taking care the cloth does not touch the membrane. Wait approximately 10 minutes for temperature stabilization.
2. Switch to TEMPERATURE and read. Refer to Table 1 in the YSI manual - Solubility of Oxygen in Fresh Water, and determine calibration value.
3. Determine altitude or atmospheric correction factor from Table II in the YSI manual.
4. Multiply the calibration value from Table 1 by the correction factor from Table II.

Example

Assume temperature = 21°C and altitude = 1,000 feet. From Table I, the calibration value for 21°C is 8.9 mg/l. From Table II, the correction factor for 1,000 feet is about 0.96. Therefore, the corrected calibration value is $8.9 \text{ mg/l} \times 0.96 = 8.54 \text{ mg/l}$.

5. Switch to the appropriate mg/l range, set the SALINITY knob to zero and adjust the CALIBRATE knob until the meter reads the correct calibration value from Step 4. Wait two minutes to verify calibration stability. Readjust is necessary.

The probe is now calibrated and should hold this calibration value for at least 8 hours. Calibration can be disturbed by physical shock, contact with the membrane, or electrolyte dehydration. Check calibration after each well measurement and in time a realistic schedule for recalibration under field conditions will be apparent.

FILTRATION UNIT

Samples collected for dissolved metals analysis will be filtered in the field immediately after collecting the sample. The filtering process is designed to remove suspended sediment from the sample. Such suspended material can react with the sample and may change the concentration of certain dissolved constituents. Following the filtering process, samples will be preserved using appropriate chemical preservatives.

Field filtering procedures are as follows:

1. The filtering apparatus will be set up according to the manufacturer's directions.
2. A 0.45-micron membrane filter will be used. If the sample is highly turbid, a pre-filter may be needed to prevent clogging.
3. A minimum of 500 ml of reagent grade water will be flushed through the filtering apparatus before filtering the sample in order to reduce the risk of altering the composition of the sample by the filtering operation.
4. The sample will be pumped through the filter and the first 100 to 200 ml discarded.
5. The remaining volume of sample will be collected in the RAS metal sample containers.
6. The filter membrane (and the pre-filter if used) will be removed after the sample is collected and discarded.
7. The filtering apparatus and tubing will be flushed with 500 ml reagent grade water.
8. The filter apparatus will then be reassembled for the next sample.
9. The sample label, traffic reports, and chain of custody forms will indicate that the sample was field filtered.

Standard Operating Procedure
for the
Measurement of pH in the Field
Using the Fisher Accumet Model 955 Portable
pH/mV Temperature Meter

1. Parameter to be measured: pH.
2. Range of Measurement: 0.00 to 14.00 pH units.
3. Sample Matrix.

This method is applicable to drinking, surface, saline, and groundwater samples; chemical domestic and industrial wastes; leachates.

4. Principle, Scope, and Application.

The pH of a sample is determined electrometrically, using a combination sample-reference pH electrode.

5. Interferences and Corrective Action.

- 5.1 Any sample constituent which coats the electrode can cause sluggish response. This can be eliminated by cleaning the electrode according to manufacturer's instructions.
- 5.2 Temperature effects on the electrometric measurement of pH arise from two sources. The first source is caused by change in electrode output at various temperatures. This is avoided by using the Automatic Temperature Compensation (ATC) probe. The second source is the change of pH inherent in the sample at various temperatures. Therefore, the sample temperature should be reported with the pH.

6. Safety Precautions.

Common sense will eliminate the possibility of any hazards while the portable pH meter is being used. Obviously, buffers and field samples must never be pipetted by mouth. Handle the electrode carefully to avoid breakage. Since the electrode will be measuring potentially hazardous material and all pH electrodes leak small quantities of electrolytes, they must never be placed in the mouth.

7. Sample Size, Collection, Preservation, and Handling.

Collect approximately 50 ml or more of the sample to be measured. To avoid the possibility of cross contamination from sample to sample and contamination of leaking electrolyte, the samples will be discarded after pH measurement and not used for any other parameters. If for any reason the pH cannot be taken immediately in the field, samples must be stored at 4°C and measured within a 24-hour period.

8. Apparatus and Materials.

- 8.1 Fisher Accumet Model 955 Portable pH/mV Temperature Meter
- 8.2 Three or more 50 ml plastic beakers
- 8.3 Commercially prepared pH 4.01, 7.00, 10.00 buffers
- 8.4 Squeeze type wash bottle, 125 ml or larger
- 8.5 Distilled water
- 8.6 Electrode; extra electrolyte for filling if necessary
- 8.7 Automatic Temperature Compensation (ATC) Probe
- 8.8 One or two 9-volt transistor batteries

9. Routine Preventive Maintenance.

- 9.1 The instrument and batteries should be checked and calibrated in the laboratory before the field effort begins.
- 9.2 The accuracy of the buffer solutions used for field and laboratory calibration should be checked. Buffer solutions need to be changed due to degradation upon exposure to the atmosphere. (The date of preparation of each buffer should be included on the bottle label.) Record source of buffer and date opened on Field Meter Log Sheet.
- 9.3 Immerse the tip of the electrodes in water overnight. If this is not possible due to field conditions, immerse the electrode tip in water for at least an hour before use. The electrode tip may be immersed in a rubber or plastic sack containing buffer solution for field transport or storage. This is not applicable for all electrodes, as some must be stored dry.
- 9.4 Make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).
- 9.5 Distilled water pH and conductivity should be monitored periodically.
- 9.6 The electrode should be stored and cleaned according to manufacturer's instructions.

10. Reagents and Calibration Standards.

Commercially prepared standardized buffers of pH 4.01, 7.00, and 10.00 are used to calibrate the instrument. The source and date opened will be recorded on the Field Meter Log Sheet.

11. Calibration Procedure.

Fisher Accumet Model 955 Calibration

To measure the pH values of samples that vary over a range wider than two pH units, a two-point calibration will be done daily before field use to compensate for less than 100 percent electrode efficiency. The STANDARDIZE control provides the first set-point. The slope control sets the second set-point.

At pH 7, this "slope" adjustment has no effect on the readings. As readings increasingly differ from pH 7, the adjustment's effect becomes more pronounced - always in the opposite direction from one side of pH 7 to the other. Therefore, both calibration set points should be on the same side of pH 7.

Choose two buffer solutions with values that bracket the desired measuring range, usually pH 7 and pH 10 for groundwater and surface water. The buffer closest to pH 7 in value should always be used for the first set-point (with the STANDARDIZE control), and the buffer furthest from pH 7 in value should always be used for the second set-point (with the SLOPE control).

pH 7 Buffer Calibration:

- a. Observe that electrode lead is securely connected to INPUT jack on instrument top panel. Also be sure to remove protective cot from tip of supplied combination electrode.
- b. Observe that plug of ATC Probe is securely connected to °C jack on instrument right-side panel.
- c. Obtain pH 7 buffer and ensure that buffer temperature is within 10°C of sample temperature.
- d. Immerse electrode system and ATC Probe into buffer solution.
- e. Set FUNCTION selector to °C position and place ON-OFF switch to ON position. Set the slope control full counter clockwise.
- f. Allow electrode system and buffer solution to reach thermal equilibrium (°C reading steady), then determine exact pH of buffer solution from the table of buffer pH versus temperature found on the bottle label.
- g. Set FUNCTION selector pH position, then adjust STANDARDIZE control until digital display indicates the pH value of buffer solution.
- h. Remove electrode system and ATC Probe from buffer solution and rinse them with distilled water.

pH 10 (or 4) Buffer Calibration:

- a. Immerse the electrode system and ATC probe into the pH 10 buffer.
- b. Set the FUNCTION selector to C position. Allow the electrode system and buffer solution to reach thermal equilibrium (°C reading steady), then determine the exact pH of the buffer solution from the table of buffer pH versus temperature found on the bottle label.
- c. Set the FUNCTION selector to the pH position, then adjust the SLOPE control until the digital display indicates the pH value of the buffer solution.
- d. Remove the electrode system and ATC probe from the buffer solution and rinse with distilled water.
- e. The pH meter is now ready for sample measurements.

Notes:

Thermal equilibrium normally requires about 1 minute, but will vary depending upon temperature difference between electrode system and buffers.

12. Sample Preparation.

There is no sample preparation for this procedure other than allowing the electrode system and sample solution to reach thermal equilibrium (steady thermometer reading).

13. Analytical Measurement.

13.1 Calibrate the instrument (See Section 11).

13.2 Remove electrode system and ATC Probe from buffer solution and rinse them with distilled water.

13.3 Immerse the electrode system and ATC Probe into the sample solution and allow sufficient time for the electrode system and sample solution to reach thermal equilibrium.

Notes: Thermal equilibrium normally requires about 1 minute, but will vary depending upon temperature difference between electrode system and sample.

13.4 Read the pH value of sample from the digital display and record on the Well Purging and Sample Collection form. Remove electrode system and ATC probe from sample and rinse with distilled water. Repeat step 13.3 and 13.4 for remaining samples.

13.5 ON-OFF switch to OFF after last measurement.

14. Data Deliverables.

The pH accuracy will be assessed by performing two measurements on three standard buffer solutions. Each measurement will be within $\pm 0.05\%$ standard unit of the certified value for the buffer solutions. Precision will be assessed through replicate measurements on field samples. The standard deviation of four replicate measurements must be less than or equal to 0.1 standard unit. The electrode will be withdrawn, rinsed with deionized water, and re-immersed between each replicate. Calibration and verification will be done in the field before the first replicate and after the last. The instrument used will be capable of providing measurements of 0.01 standard unit. The instrument will be calibrated at least once daily and every 10 samples and results recorded on the Field Meter Instrument Calibration Log. Field replicates will be done at a frequency of every 10 samples. This will be done in quadruplicate. All field sample measurements will be recorded on the Well Purging and Sample Collection form.

15. Quality Control Requirements.

Quadruplicate samples will be done every 10 samples by rinsing the electrode after the initial reading, waiting 1 full minute, and then measuring the next sample. The standard deviation of four replicate measurements must be less than or equal to 0.1 standard unit.

16. References.

Material for this SOP was obtained from the Instruction Manual for the Fisher Accumet Model 955 Portable pH/mV Temperature Meter, Catalog No. 69348.

17. Method Validation Data.

The parameter of pH is being measured for field screening to select sampling locations and method validation data is, therefore, not required.

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7. Sample Size, Collection, Preservation, and Handling.

Samples should be collected in clean glass or plastic containers. The volume should be such that the cell plates of the probe are completely immersed in the sample. Samples may be filtered through a 4.5 m filter before analysis if necessary. Specific conductance should be measured as soon after sampling as possible, however, if readings cannot be taken immediately, samples should be stored at 4°C and measured as soon as possible.

8. Apparatus and Material.

- 8.1 Cole Parmer Conductivity Meter, Model 4070
- 8.2 Conductivity probe
- 8.3 Automatic Temperature Compensation (ATC) probe
- 8.4 Clean sample containers
- 8.5 Squeeze-type wash bottle, 125 ml or larger
- 8.6 Deionized water
- 8.7 Calibration standard solution
- 8.8 Laboratory wipes - KimWipe or equivalent
- 8.9 Replacement batteries, types PP3, 6F12, or MN1640

9. Routine Preventative Maintenance.

It is necessary to keep the external surfaces clean and free from dust.

All conductivity probes should be thoroughly rinsed after use and stored in deionized water. Particular care should be taken to ensure that the electrical connections are free from dirt and debris. It is recommended that the instrument be checked and calibrated before going into the field. The symbol "BAT" will appear on the display if the batteries need replacing.

10. Reagents and Calibration Standards.

Potassium chloride standard solutions with a specific conductance closest to the values expected in the field should be used. The table below may be used for guidance:

SPECIFIC CONDUCTANCE OF KCl SOLUTIONS AT 25 DEGREES CENTIGRADE

<u>Concentration</u> mol/l	<u>Specific Conductance</u>	
	mg/l	umhos/cm
0.0001	7.456	14.94
0.0005	37.28	73.90
0.001	74.56	147.0
0.005	372.8	717.8
0.00702	523.4	1000
0.01	745.6	1413
0.02	1591.2	2767

NOTE: This table has been modified from Standard Methods for the Examination of Water and Wastewater (1980).

APPENDIX D

FIELD METER CALIBRATION PROCEDURES

ENU Model PI 101

Fisher Accumet Model 955

Cole Parmer Model 4070 Conductivity Meter

YSI Model 54A Dissolved Oxygen Meter

Mini CONRAD II Portable Radiological Survey Meter

Lumidor Gasponder IV Model PGM-14

HNu Model PI 101 Calibration

The calibration of the HNu is to be checked daily before field use by using a cylinder of isobutylene (HNu pn 101-350) with a regulator (HNu pn 101-351).

The ppm isobutylene reading, along with the span setting, is recorded in the calibration report contained in the HNu case (35 ppm, span 9.8).

In the field, the calibration must be checked daily before use and readjusted, if necessary, by using this cylinder and regulator as follows:

1. Connect the analyzer to the regulator and cylinder with a short piece of clean tygon tubing.
2. With the SPAN setting at 9.8 and the function switch at the same positions as listed on the Isobutylene Calibration Report, open the valve on the cylinder until a steady reading is obtained.
3. If the reading is 35 ppm, the analyzer calibration for the original species of interest is still correct.
4. If the reading has changed, adjust the SPAN setting until the reading is 35 ppm.
5. Shut off the cylinder as soon as the reading is established.
6. Record and maintain this new SPAN setting.

Notes:

- A. The regulator sets and controls the flow rate of gas at a value preset at the factory. This will be about 100 to 200 cc/min.; no adjustment to the regulator is necessary in the field.
- B. Do not use the cylinder below about 30 psig as readings below that level can deviate up to 10 percent from the rated value.
- C. Safely discard the disposable cylinder when empty and do not refill. It is against the law to transport refilled cylinders.

Fisher Accumet Model 955 Calibration

To measure the pH values of samples that vary over a range wider than two pH units, a two-point calibration will be done daily before field use to compensate for less than 100 percent electrode efficiency. The STANDARDIZE control provides the first set-point. The slope control sets the second set-point.

At pH 7, this "slope" adjustment has no effect on the readings. As readings increasingly differ from pH 7, the adjustment's effect becomes more pronounced - always in the opposite direction from one side of pH 7 to the other. Therefore, both calibration set points should be on the same side of pH 7.

Choose two buffer solutions with values that bracket the desired measuring range, usually pH 7 and pH 10 for groundwater and surface water. The buffer closest to pH 7 in value should always be used for the first set-point (with the STANDARDIZE control), and the buffer furthest from pH 7 in value should always be used for the second set-point (with the SLOPE control).

pH 7 Buffer Calibration:

1. Observe that electrode lead is securely connected to INPUT jack on instrument top panel. Also, be sure to remove protective cot from tip of supplied combination electrode.
2. Observe that plug of ATC Probe is securely connected to °C jack on instrument right-side panel.
3. Obtain pH 7 buffer and ensure that buffer temperature is within 10°C of sample temperature.
4. Immerse electrode system and ATC Probe into buffer solution.
5. Set FUNCTION selector to °C position and place ON-OFF switch to ON position. Set the slope control full counter clockwise.
6. Allow electrode system and buffer solution to reach thermal equilibrium (°C reading steady), then determine exact pH of buffer solution from the table of buffer pH versus temperature found on the bottle label.
7. Set FUNCTION selector pH position, then adjust STANDARDIZE control until digital display indicates the pH value of buffer solution.
8. Remove electrode system and ATC Probe from buffer solution and rinse them with distilled water.

pH 10 (or 4) Buffer Calibration:

1. Immerse the electrode system and ATC probe into the pH 10 buffer.
2. Set the FUNCTION selector to C position. Allow the electrode system and buffer solution to reach thermal equilibrium (°C reading steady), then determine the exact pH of the buffer solution from the table of buffer pH versus temperature found on the bottle label.
3. Set the FUNCTION selector to the pH position, then adjust the SLOPE control until the digital display indicates the pH value of the buffer solution.
4. Remove the electrode system and ATC probe from the buffer solution and rinse with distilled water.
5. The pH meter is now ready for sample measurements.

Notes:

Thermal equilibrium normally requires about one minute, but will vary depending upon temperature difference between electrode system and buffers.

Cole Parmer Model 4070 Conductivity Meter

Two options for calibration of the Model 4070 are available in the field, depending on instrument accessory availability. If the pre-calibrated probe is available, this is the easiest calibration procedure to do in the field. However, if the probe is not available, calibration will have to be done daily before field use with a standard solution (commercially prepared):

Calibration with Pre-Calibrated Probe:

1. Connect a standard pre-calibrated probe to the unit.
2. Select the "Set K" position on the function switch.
3. Adjust the "Set K" control until the display indicates the value of the cell constant as marked on the probe being used.
4. The standard X 1.0 probe has a cell constant range from 0.80 to 1.20 and is calibrated to 2 decimal places. The display should be set to indicate this figure exactly.

The standard X 10 probe has a cell constant range from 8.0 to 12.0 and is calibrated to 1 decimal place. The display should be set to indicate this figure shifted one place to the right.

The standard X 0.1 probe has a cell constant range from 0.08 to 0.12 and is calibrated to 2 decimal places. The display should be set to indicate this figure shifted one place to the left.

5. Before using the 20 uS range, the probe should be thoroughly rinsed in deionized water, excess water shaken off and the outside of the probe body wiped dry. The display should then be set to zero, with the probe in free air, by using the "Zero 20 uS" control.

Calibration with a Standard Solution:

1. Select the "COND" range.
2. Immerse the conductivity cell and A.T.C. probe (if separate probe is being used) into the prepared standard.
3. Select the 2000 uS range if using a 1000 uS or 1413 uS standard or other suitable range if an alternative standard is being used.
4. Adjust the "Set K" control to give the exact readout of the standard solution selected on the display.
5. After carrying out the calibration with standard solutions as detailed above and with the probe still in the standard solution and the display set to the value of the standard solution, switch to the "Set K" range to give a direct readout of the cell constant.
6. If the readout cannot be set to the value of the standard solution with the "Set K" control, then the cell constant lies outside the "Set K" range of 0.80 to 1.20. In such cases, the display should be set to read 1.00 on the "Set K" position, the display reading on the range giving the best resolution should be noted and the cell constant calculated from the following formula:

K - Conductivity of Standard Solution
Display Reading

This figure should be noted and (with the cell constant set to 1.00 on the "Set K" position) the display reading should be multiplied by this figure to obtain the correct conductivity.

Note:

Ensure that the conductivity standard has not reached or gone over the expiration date marked on the container.

YSI Model 54A Dissolved Oxygen Meter Calibration

The air calibration procedure described below should be done daily before field use:

1. Place the probe in the YSI 5075A calibration chamber along with a few drops of distilled water.
2. Wait approximately 10 minutes for temperature stabilization.
3. Switch to TEMPERATURE and read. Refer to Table I - Solubility of Oxygen in Fresh Water and determine calibration value.
4. Determine altitude or atmospheric correction factor using Table II.
5. Multiply Table I calibration value by the Table II correction factor.
6. Switch to the appropriate mg/L range and adjust the CALIBRATE knob until the meter reads the value calculated in Step 5. Wait two minutes to verify calibration stability. Readjust if necessary.

Table 1 shows the amount of oxygen in mg/l that is dissolved in air saturated fresh water at sea level (760 mmHg atmospheric pressure) as temperature varies from 0° to 45°C.

TABLE 1
SOLUBILITY OF OXYGEN IN FRESH WATER

<u>Temperature</u> <u>°C</u>	<u>mg/l Dissolved</u> <u>Oxygen</u>	<u>Temperature</u> <u>°C</u>	<u>mg/l Dissolved</u> <u>Oxygen</u>
0	14.60	23	8.56
1	14.19	24	8.40
2	13.81	25	8.24
3	13.44	26	8.09
4	13.09	27	7.95
5	12.75	28	7.81
6	12.43	29	7.67
7	12.12	30	7.54
8	11.83	31	7.41
9	11.55	32	7.28
10	11.27	33	7.16
11	11.01	34	7.05
12	10.76	35	6.93
13	10.52	36	6.82
14	10.29	37	6.71
15	10.07	38	6.61
16	9.85	39	6.51
17	9.65	40	6.41
18	9.45	41	6.31
19	9.26	42	6.22
20	9.07	43	6.13
21	8.90	44	6.04
22	8.72	45	5.95

Source: Derived from 15th Edition "Standard Methods for the Examination of Water and Wastewater."

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Table II shows the correction factor that should be used to correct the calibration value for the effects of atmospheric pressure or altitude. Find true atmospheric pressure in the left hand column and read across to the right hand column to determine the correction factor. (Note that "true" atmospheric pressure is as read on a barometer. Weather Bureau reporting of atmospheric pressure is corrected to sea level.) If atmospheric pressure is unknown, the local altitude may be substituted. Select the altitude in the center column and read across to the right hand column for the correction factor.

TABLE II
CORRECTION FOR ATMOSPHERIC PRESSURE

<u>Atmospheric Pressure</u> mmHg	or	<u>Equivalent Altitude</u> Ft.	=	<u>Correction</u> Factor
775		540		1.02
760		0		1.00
745		542		.98
730		1094		.96
714		1688		.94
699		2274		.92
684		2864		.90
669		3466		.88
654		4082		.86
638		4756		.84
623		5403		.82
608		6065		.80
593		6744		.78
578		7440		.76
562		8204		.74
547		8939		.72
532		9694		.70
517		10472		.68
502		11273		.66

Source: Derived from 15th Edition "Standard Materials for the Examination of Water and Wastewater."

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MiniCONRAD II Portable Radiological Survey Meter

The manufacturer recommends that the Mini CONRAD only be calibrated semi-annually. Determine from the instrument log last date of calibration and assess if in-field calibration will be needed. The calibration procedure is as follows:

1. Place the range switch in the low (x1) position.
2. Remove the "x1" plastic screw that covers the low-range calibration control.
3. Turn the MiniCONRAD II on and place the target center in the appropriate field for the instrument being calibrated: Model 3034 3 mR/h.
4. Adjust the "x1" control for the proper indication on the meter scale.
5. Reduce the field by approximately 50 percent. The MiniCONRAD II must indicate within 15 percent of the field value.
6. Replace the "x1" plastic screw.
7. Place the range switch in the high (x100) position, remove the "x100" plastic screw and place the MiniCONRAD II target center in the appropriate field: Model 3034 300 mR/h.
8. Adjust the "x100" control for the proper indication on the meter scale. The field intensity is 100 times the value indicated.
9. Reduce the field by approximately 50 percent. The MiniCONRAD II reading, multiplied by 100, must be within 15 percent of the field.
10. Replace the "x100" plastic screw and turn the MiniCONRAD II OFF.

Note:

For calibration purposes, the "target center" is the intersection of the targets on the case.

Lumidor Gasponder IV Model PGM-14 Calibration

Calibration should be done at least daily before field use and after 12 hours of continuous use. Before proceeding, ensure that Gasponder is fully charged.

I. Initial Calibration

1. Instrument should be run at least 15 minutes.
2. Place Selector on "BATT.TEST" - check reading.
3. Place Selector on H₂S and set "ZERO."
4. Place Selector on CH₄ and set "ZERO."
5. Before proceeding with calibration, examine the calibration kit model PGM-14-10X to ensure that it contains:

One cylinder of Methane/CO	(Approx. 50 percent LEL/250 PPM CO)
One cylinder of H ₂ S	(Approx. 25 PPM)
One Gas Regulator and Hose	(Use only the regulator provided <u>with the kit</u>)

II. Calibration

1. Locate opening provided at side of main case to gain access to calibration adjustment for H₂S and CH₄.
2. Attach flow regulator on Methane/CO cylinder.
3. With Selector set to "CH₄," check "ZERO" setting. If necessary, readjust with panel adjustment only.
4. Repeat Step 3 for "H₂S."
5. Return Selector switch to the "CH₄" position. Turn on flow regulator, and connect hose to unit using quick disconnect fitting.
6. After one minute, adjust calibration screw until reading is the same as stated on cylinder label (i.e., 50 percent LEL).
7. Turn off flow regulator and remove regulator from cylinder.
8. Attach flow regulator to cylinder marked H₂S (RED).
9. Turn selector switch to the H₂S position. Turn on flow regulator and connect hose to unit using quick disconnect fitting. After three minutes, adjust calibration screw until reading is the same as stated on cylinder (i.e., 25 PPM). Disregard "O₂" alarm that occurs during this test.
10. When calibration procedure is completed, remove the gas regulator from cylinder, carefully repack all components and replace calibration cover securely.

ARCS/P/HIMCO/AE8

APPENDIX E
STANDARD OPERATING PROCEDURES
FOR
FIELD MEASUREMENTS

Volatile Organics by HNU

pH

Conductivity

Dissolved Oxygen

Radioactivity

Methane and Hydrogen Sulfide

STANDARD OPERATING PROCEDURE FOR THE
FIELD MEASUREMENT OF VOLATILE ORGANICS BY HNu

I. PARAMETER(S)

Volatile organics with ionization potentials of less than 10.2 eV.

II. RANGE OF MEASUREMENT

The linear range is 0.1-400 ppm, the useful range is 0.1-2000 ppm.

III. LIMIT OF DETECTION

The detection limit of 0.1 ppm was determined by the manufacturer based on the response of benzene at a span setting of 9.8 and a 10.2 eV probe.

IV. SAMPLE MATRICES

Headspace above soil samples collected in split spoon samplers or with trowels.

V. PRINCIPLE, SCOPE AND APPLICATION

The analyzer measures the concentration of trace gases present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule in electron volts (eV) is less than the energy of the photon. The source of photons is an ultraviolet lamp with an energy of 10.2 eV.

Sample gases enter through the inlet into the ion chamber and are exposed to photons emanating from the ultraviolet lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive-biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.

In service, the analyzer is first calibrated with a gas of known composition equal, close to, or representative of that to be measured. Gases with ionization potentials near to or less than 10.2 eV will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials higher than 10.2 eV will not be detected.

Ionization potentials for various atoms, molecules and compounds are given in the Instruction Manual Appendix. The ionization potential of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range from about 12.0 eV to about 15.6 eV and are not ionized by any of the three lamps. Gases

with ionization potentials near to or slightly higher than the lamp are partially ionized, with low sensitivity.

VI. INTERFERENCES AND CORRECTIVE ACTIONS

Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings. Soil, dust, or debris drawn into the probe will result in low readings and/or negative deflection of the meter. High ambient humidity and high percent moisture samples will cause negative deflection of the meter.

To obtain stable, reproducible readings, corrective actions such as shielding the probe from drafts or currents and rain should be done. Sample moisture content is not controllable as representativeness dictates that no special handling of the sample occurs that might bias chemical results. Any drying of the sample would result in loss of volatiles. The field records should indicate which samples were wet and note any negative meter deflection.

VII. SAFETY PRECAUTIONS

Do not look at the light source closer than 6 inches with unprotected eyes. Observe only if necessary, then only briefly. Continued exposure to ultraviolet energy generated by the light source can be harmful to eyesight.

The instrument measures gases in the vicinity of the operator and a high reading when measuring toxic or explosive gases should be cause for action for operator safety.

Use HNu only in an emergency with a low battery when on battery charge.

Turn the function switch on the control panel to the OFF position before any disassembly. Otherwise, high voltage of 1200 vdc will be present. Use great care when operating the analyzer with the readout assembly outside its case due to the presence of 1200 vdc.

Do not interchange lamps of different eV ratings in a probe. Amplifier and components are selected for a specific eV lamp. A probe with the wrong lamp will not operate properly.

VIII. SAMPLE SIZE, COLLECTION, PRESERVATION AND HANDLING

Soil

Measurement is done on the soil contained in the split spoon sampler or trowel placed in a clean 8-ounce jar with a teflon-lined lid. Measurement should be made within 5 minutes of collection in the field. The jar should be half full.

IX. APPARATUS

- Clean 8-ounce clear glass jars with teflon-lined lid, hole the diameter of the HNu probe drilled in top.

- Duct tape.
- HNu Model PI 101.
- Isobutylene calibration gas cylinder and regulator.
- Spare 10.2 eV lamps.
- Battery charger.

X. ROUTINE PREVENTIVE MAINTENANCE

1. Battery

Check the battery charge during each period of operation, at least once daily. If the battery is low as indicated by the meter reading or the warning indicator, it is necessary to recharge the battery.

2. Lamp

During periods of operation of the analyzer, dust or other foreign matter could be drawn into the probe forming deposits on the surface of the UV lamp or in the ion chamber. This condition is indicated by meter readings that are low, erratic, unstable, non-repeatable, or drifting, or show apparent moisture sensitivity. These deposits interfere with the ionization process and cause erroneous readings. Check for this condition daily. Cleaning can be accomplished as follows:

- a. Disassemble the probe and remove the lamp and ion chamber. Exercise great care in doing so to prevent inadvertent damage to these components.
- b. First check the lamp window for fouling by looking at the surface at an incident angle. Any deposits, films or discoloration may interfere with the ionization process. Clean the window as follows:
 - 1) First clean by rubbing gently with lens tissue dipped in a detergent solution.
 - 2) If this does not remove deposit, apply a small amount of HNu cleaning compound (PA101534) directly onto the lens of the lamp and spread evenly over surface with a non-abrasive tissue (e.g. Kim-Wipe) or a lens tissue.
 - 3) Wipe off compound with a new tissue.
 - 4) Rinse with a warm water (about 80°F) or damp tissue to remove all traces of grit or oils and any static charge that may have built up on the lens. Dry with new tissue.
 - 5) Reinstall lamp in detector and check analyzer operation.
 - 6) If performance is still not satisfactory, replace the lamp.

3. Ion Chamber

- a. Inspect the ion chamber for dust or particulate deposits. If such matter is present, the chamber can be cleaned by removing the outer Teflon ring, and the four screws holding the retaining ring. Carefully move the retaining ring aside (NOTE: this is soldered) and remove the screen. A tissue or cotton swab, dry or wetted with methanol, can be used to clean off any stubborn deposits. The assembly can also be gently swirled in methanol and dried gently at 50-60°C for approximately a half hour. No liquid must be present at reassembly as this would affect the performance. Do not clean the ion chamber with the HNu cleaning compound.
- b. Reassemble the probe and check analyzer operation.
- c. If performance is still not satisfactory, replace the lamp.

XI. REAGENTS AND CALIBRATION STANDARDS

The calibration gas cylinder containing a certified value of isobutylene is the only reagent/standard. Replace when empty, no shelf life is applicable.

XII. CALIBRATION PROCEDURES

The calibration of the HNu is to be checked daily before field use by using a cylinder of isobutylene (HNu pn 101-350) with a regulator (HNu pn 101-351).

The ppm isobutylene reading, along with the span setting, is recorded in the calibration report contained in the HNu case (35 ppm, span 9.8).

In the field, the calibration must be checked daily before use and readjusted, if necessary, by using this cylinder and regulator as follows:

1. Connect the analyzer to the regulator and cylinder with a short piece of clean tygon tubing.
2. With the SPAN setting at 9.8 and the function switch at the same positions as listed on the Isobutylene Calibration Report, open the valve on the cylinder until a steady reading is obtained.
3. If the reading is 35 ppm, the analyzer calibration is still correct.
4. If the reading has changed, adjust the SPAN setting until the reading is 35 ppm.
5. Shut off the cylinder as soon as the reading is established.
6. Record and maintain this new SPAN setting.

Notes:

- A. The regulator sets and controls the flow rate of gas at a value preset at the factory. This will be about 100 to 200 cc/min.; no adjustment to the regulator is necessary in the field.
- B. Do not use the cylinder below about 30 psig as readings below that level can deviate up to 10 percent from the rated value.

- C. Safely discard the disposable cylinder when empty and do not refill. It is against the law to transport refilled cylinders.

XIII. SAMPLE PREPARATION

A. Soil

Soil obtained in split spoon samplers or by a hand trowel/corer should be placed in a clean 8-ounce clear glass jar outfitted with a teflon-lined lid with a hole the diameter of the HNu probe drilled in it. Fill the jar half full, close tightly (lid hold should be covered with duct tape) and allow to equilibrate for 2 minutes before measurement.

XIV. ANALYTICAL MEASUREMENT

1. Unclamp the cover from the main readout assembly.
2. Remove the inner lid from the cover by pulling out the two fasteners.
3. Remove the probe, handle and cable from the cover. Attach the handle to the front part of the probe.
4. Connect the probe cable plug to the 12 pin keyed socket on the readout assembly panel. Carefully match the alignment slot in the plug to the key in the connector. Screw down the probe connector until a distinct snap and lock is felt.
5. Screw the probe extension into the probe end cap. The probe may be used without the extension if desired.
6. Set the SPAN control for 10.2 eV as specified by the daily in-field calibration with isobutylene.
7. Turn the function switch to the BATT (battery check) position. The needle on the meter will go to the green zone if the battery is fully charged. If the needle is below the green arc or if the Low Battery Indicator comes on, the battery must be recharged before the analyzer is used.
8. Set SPAN pot to 9.8.
9. Turn the function switch to the STANDBY position. Turn the zero adjustment until the meter needle is at zero.
10. Calibrate the instrument daily as described in Section 12.
11. Turn the function switch to the appropriate operating position. Start with the 0-2000 position and then switch to the more sensitive ranges. The UV light source should be on, confirmed by briefly looking into the probe to observe the purple glow from the lamp.

12. Peel back the duct tape from the lid and place the HNu probe in the hole. Record the reading on the Soils Data Form.
13. After completion of each days measurements, check battery condition as described in No. 7.
14. Turn function switch to OFF position.
15. When not operating, leave analyzer in assembled condition, and connected to battery charger.
16. When transporting, disassemble probe and extension from readout assembly and return equipment to its stored condition.
17. In case of emergency, turn function switch to OFF position.

XV. FLOW CHART

Not applicable.

XVI. DATA TREATMENT

Not applicable, instrument provides direct real time readout in ppm units.

XVII. DATA DELIVERABLES

Record calibration details on Field Instrument Calibration Log and results on Soils Data Form.

XVIII. QUALITY CONTROL REQUIREMENTS

Each day an upwind location will be used to determine the ambient background level. One location for every ten will be selected for measurement as a field duplicate. Two separate aliquots of soil will be placed in two 8-ounce jars. No rpd limits have been established for field duplicate precision. Record both reading on the Soils Data Form.

XIX. REFERENCES

- Instruction Manual, HNu Model PI 101 Portable Ionization Analyzer, December, 1985.
- HNu Systems (617) 964-6690

XX. METHOD VALIDATION DATA

Not applicable as volatile organics are being measured for field screening purposes to select sampling locations for chemical analysis.

ARCS/PROJ/HIMCO/AF3

Standard solutions may be stored at 4°C for up to one week. Date of preparation can be noted on the container and on the Field Meter Instrument Calibration Log.

11. Calibration Procedures.

Cole Parmer Model 4070 Conductivity Meter

Two options for calibration of the Model 4070 are available in the field, depending on instrument accessory availability. If the pre-calibrated probe is available, this is the easiest calibration procedure to do in the field. However, if the probe is not available, calibration will have to be done daily before field use with a standard solution (commercially prepared):

Calibration with Pre-Calibrated Probe:

- a. Connect a standard pre-calibrated probe to the unit.
- b. Select the "Set K" position on the function switch.
- c. Adjust the "Set K" control until the display indicates the value of the cell constant as marked on the probe being used.
- d. The standard X 1.0 probe has a cell constant range from 0.80 to 1.20 and is calibrated to 2 decimal places. The display should be set to indicate this figure exactly.

The standard X 10 probe has a cell constant range from 8.0 to 12.0 and is calibrated to 1 decimal place. The display should be set to indicate this figure shifted one place to the right.

The standard X 0.1 probe has a cell constant range from 0.08 to 0.12 and is calibrated to 2 decimal places. The display should be set to indicate this figure shifted one place to the left.

- d. Before using the 20 uS range, the probe should be thoroughly rinsed in deionized water, excess water shaken off and the outside of the probe body wiped dry. The display should then be set to zero, with the probe in free air, by using the "Zero 20 uS" control.

Calibration with a Standard Solution:

- a. Select the "COND" range.
- b. Immerse the conductivity cell and A.T.C. probe (if separate probe is being used) into the prepared standard.
- c. Select the 2000 uS range if using a 1000 uS or 1413 uS standard or other suitable range if an alternative standard is being used.
- d. Adjust the "Set K" control to give the exact readout of the standard solution selected on the display.
- e. After carrying out the calibration with standard solutions as detailed above and with the probe still in the standard solution and the display set to the value of the standard solution, switch to the "Set K" range to give a direct readout of the cell constant.

- f. If the readout cannot be set to the value of the standard solution with the "Set K" control, then the cell constant lies outside the "Set K" range of 0.80 to 1.20. In such cases, the display should be set to read 1.00 on the "Set K" position, the display reading on the range giving the best resolution should be noted and the cell constant calculated from the following formula:

$$K = \frac{\text{Conductivity of Standard Solution}}{\text{Display Reading}}$$

This figure should be noted and (with the cell constant set to 1.00 on the "Set K" position) the display reading should be multiplied by this figure to obtain the correct conductivity.

Note:

Ensure that the conductivity standard has not reached or gone over the expiration date marked on the container.

12. Sample Preparation.

If the sample contains a great deal of particulate matter which may interfere with readings, they may be filtered through a 4.5 m filter.

13. Analytical Measurement.

- 13.1 Calibrate the instrument (See Section 11).
- 13.2 Rinse the conductivity probe and the ATC probe thoroughly with deionized water, shake to remove internal droplets, and the outside should be wiped before immersing into sample.
- 13.3 Allow the readout on the instrument to settle (usually about one minute). Multiply the instrument readout by the correction factor determined during calibration. Record the corrected conductivity on the Well Purging and Sample Collection form.
- 13.4 Step 13.2 should be repeated after every sample to prevent cross-contamination.
- 13.5 On completion of sample measurement, the probes should be thoroughly rinsed in deionized water and for short term storage should be kept immersed in deionized water so that the plates remain wetted. For longer term storage, the probes should be thoroughly rinsed in deionized water, the outside of the probes wiped dry, and the probes stored dry. It should be noted that it may take some time for stability to be achieved when a dry probe is first used while the plate becomes re-wetted.

14. Data Deliverables.

Initial calibration of the instrument and continuing calibration check results will be recorded on the Field Meter Instrument Calibration Log form. Summary of sample analysis will be recorded on the Well Purging and Sample Collection form, including sample duplicates.

15. Quality Control Requirements.

The meter will be read to the nearest 10 umhos/cm within a range of 0 to 20,000 umhos/cm. Accuracy of measurements shall be ± 5 percent of a standard. The meter will be calibrated at least once daily and after every 10 field samples. Field duplicates will be measured at a frequency of every 10 samples by thoroughly rinsing the probes in deionized water, waiting one full minute, and then immersing probes in the duplicate sample. Precision shall be a standard deviation of ± 10 percent.

16. References.

Material for this SOP was obtained from the Instruction Manual for the Cole Parmer Model 4070 Conductivity Meter.

17. Method Validation Data.

The parameter of specific conductance is being measured for field screening to select sampling locations, and method validation data is, therefore, not required.

ARCS/P/HIMCO/AF4

Standard Operating Procedure for Field
Measurement of Dissolved Oxygen

I. PARAMETER

Dissolved Oxygen in mg/l

II. RANGE OF MEASUREMENT

0-10 and 0-20 mg/l

0-5 and 0-10 mg/l with high sensitivity membrane

III. LIMIT OF DETECTION

0.05 mg/l on 0-10 scale

0.1 mg/l on 0-20 scale

IV. SAMPLE MATRIX

Water (surface, groundwater), residential well, wastewater

V. PRINCIPLE SCOPE AND APPLICATION

A thin permeable membrane covers a polarographic sensor. Oxygen enters the membrane, and when a polarizing voltage is applied across the sensor, oxygen reacts at the cathode causing a current to flow. The membrane passes oxygen at a rate proportional to the pressure difference across it. Oxygen is consumed at the cathode so the oxygen pressure inside the membrane is zero. The force causing the oxygen to diffuse through the membrane is proportional to the absolute pressure of oxygen outside the membrane. If the oxygen pressure increases, more oxygen diffuses through the membrane and more current flows through the sensor. A lower pressure results in less current.

VI. INTERFERENCES AND CORRECTIVE ACTIONS

Air bubbles trapped under the membrane will cause pressure-induced errors. Replace membrane after refilling with fresh electrolyte taking care not to introduce air bubbles.

H₂S, SO₂, halogens, neon, nitrous oxide, and CO are interfering gases. For water samples with chloride concentrations of greater than 20,000 mg/l, compensation must be made for the differing temperature solubility relationship of oxygen in sea water.

If the gold cathode becomes tarnished from contact with certain gases or plated with silver from extended use with a loose or wrinkled membrane, it will need to be replaced. Do not attempt to clean the cathode.

VII. SAFETY PRECAUTIONS

Disconnect battery charger before removing cover to replace batteries. When replacing batteries, positive end of battery must go to red.

VIII. SAMPLE SIZE, COLLECTION, PRESERVATION, AND HANDLING

Samples should be collected in 200 ml BOD bottles directly from the surface water body or residential tap with minimum agitation to entrain air. No preservatives are applicable as measurement should be done immediately after collection. Downhole measurement of dissolved oxygen in monitoring wells should be done.

IX. APPARATUS AND MATERIALS

YSI Model 54ARC/54ABP dissolved oxygen meter
YSI 5720A self-stirring BOD bottle probe
YSI 5739 oxygen temperature probe
Battery charger eliminator
Detachable cable leads (10-200' as applicable)
Submersible stirrer
Calibration chamber
Standard membrane and KCl Kit (includes membrane packets (0.001" thick), 30 ml KCl bottle with Kodak Photo Flo[®])
High sensitivity membrane and KCl Kit (includes membrane packets 0.0005 " thick)
Spare O rings
BOD bottles
Scissors
Spare Ni-Cad 1.25 v batteries

X. ROUTINE PREVENTIVE MAINTENANCE

Check gold cathode for tarnish or plating monthly. Send in for service annually.

Check probe for air bubbles and membrane for fouling daily and replace as necessary. Average life is 2 to 4 weeks.

Check diaphragm for puncture and evidence of leakage of electrolyte weekly. Replace, if needed, by unscrewing the retaining plug. Remove diaphragm and washer, and flush any KCl crystals from the reservoir. Install new diaphragm, convoluted side in, replace washer, and screw in retaining plug.

Rinse stirrer after each sample to maximize its life as hydrocarbons, ozone, and strong acid and bases may degrade the flexible stirrer boot.

Store probe in the bottomless plastic bottle with a small piece of moistened towel or sponge to keep electrolyte from drying out. Alternatively, store probe in BOD bottle with about one-inch of water.

Battery replacement or recharging is indicated if the red line adjustment cannot be made or calibration cannot be achieved even after probe replacement/maintenance. Battery life should be three years or longer. Recharge a minimum of 16 hours with the instrument on.

XI. REAGENTS AND CALIBRATION STANDARDS

Electrolyte solution available through YSI or make as follows:

1. Prepare a saturated solution of KCl using reagent grade KCl and distilled water.
2. Dilute saturated solution to half strength using distilled water.
3. Add two drops Kodak Photo Flo[®] per 100 ml solution to provide good wetting of the sensor.
4. Store with meter, discard after one year.

XII. CALIBRATION PROCEDURES

The air calibration procedure described below should be done daily before field use:

1. Place the probe in the YSI 5075A calibration chamber along with a few drops of distilled water.
2. Wait approximately 10 minutes for temperature stabilization.
3. Switch to TEMPERATURE and read. Refer to Table 1 - Solubility of Oxygen in Fresh Water and determine calibration value.
4. Determine altitude or atmospheric correction factor using Table II.
5. Multiply Table I calibration value by the Table II correction factor.
6. Switch to the appropriate mg/L range and adjust the CALIBRATE knob until the meter reads the value calculated in Step 5. Wait two minutes to verify calibration stability. Readjust if necessary.

Table 1 shows the amount of oxygen in mg/l that is dissolved in air saturated fresh water at sea level (760 mmHg atmospheric pressure) as temperature varies from 0° to 45°C.

TABLE 1
SOLUBILITY OF OXYGEN IN FRESH WATER

<u>Temperature</u> <u>°C</u>	<u>mg/l Dissolved</u> <u>Oxygen</u>	<u>Temperature</u> <u>°C</u>	<u>mg/l Dissolved</u> <u>Oxygen</u>
0	14.60	23	8.56
1	14.19	24	8.40
2	13.81	25	8.24
3	13.44	26	8.09
4	13.09	27	7.95
5	12.75	28	7.81
6	12.43	29	7.67
7	12.12	30	7.54
8	11.83	31	7.41
9	11.55	32	7.28
10	11.27	33	7.16
11	11.01	34	7.05
12	10.76	35	6.93
13	10.52	36	6.82
14	10.29	37	6.71
15	10.07	38	6.61
16	9.85	39	6.51
17	9.65	40	6.41
18	9.45	41	6.31
19	9.26	42	6.22
20	9.07	43	6.13
21	8.90	44	6.04
22	8.72	45	5.95

Source: Derived from 15th Edition "Standard Methods for the Examination of Water and Wastewater."

Table II shows the correction factor that should be used to correct the calibration value for the effects of atmospheric pressure or altitude. Find true atmospheric pressure in the left hand column and read across to the right hand column to determine the correction factor. (Note that "true" atmospheric pressure is as read on a barometer. Weather Bureau reporting of atmospheric pressure is corrected to sea level.) If atmospheric pressure is unknown, the local altitude may be substituted. Select the altitude in the center column and read across to the right hand column for the correction factor.

TABLE II
CORRECTION FOR ATMOSPHERIC PRESSURE

<u>Atmospheric Pressure</u> mmHg	or	<u>Equivalent Altitude</u> Ft.	-	<u>Correction</u> <u>Factor</u>
775		540		1.02
760		0		1.00
745		542		.98
730		1094		.96
714		1688		.94
699		2274		.92
684		2864		.90
669		3466		.88
654		4082		.86
638		4756		.84
623		5403		.82
608		6065		.80
593		6744		.78
578		7440		.76
562		8204		.74
547		8939		.72
532		9694		.70
517		10472		.68
502		11273		.66

Source: Derived from 15th Edition "Standard Materials for the Examination of Water and Wastewater."

XIII. SAMPLE PREPARATION

None required, analyze immediately.

XIV. ANALYTICAL MEASUREMENT

1. With the instrument prepared for use and the probe calibrated, place the probe in the sample to be measured and provide stirring by:
 - a. Downhole well measurement - use YSI submersible stirrer, or provide manual stirring by raising and lowering the probe about 1 ft/sec.
 - b. Surface water and tap water measurements - place sample in BOD bottle and use self-stirring BOD bottle probe or magnetic stirrer.
2. Allow sufficient time (at least one minute) for probe to stabilize to sample temperature and dissolved oxygen.
3. Read dissolved oxygen and record on Well Purging and Sample Collection Form.

XV. FLOW CHART

Not applicable.

XVI. DATA TREATMENT

Not applicable, read dissolved oxygen directly in mg/l.

XVII. DATA DELIVERABLES

Complete Field Meter Instrument Calibration Log and note any preventive maintenance done. Record sample dissolved oxygen, date, time, and analyst on Well Purging and Sample Collection Form under comments column.

XVIII. QUALITY CONTROL REQUIREMENTS

No blanks, spikes, reference, or QC samples are applicable.

Every tenth sample analyzed, or at least once daily, sample will be analyzed in duplicate by collecting a fresh aliquot of sample or raising the submersible probe and reintroducing it into the well to take a duplicate dissolved oxygen measurement. Error associated with just the instrument is ± 0.05 mg/l or 5%, therefore, field duplicates are likely to agree within ± 0.1 mg/l or 10%. If the variation is larger, check instrument probe, battery, and diaphragm conditions.

XIX. REFERENCES

1. Instruction Manual YSI Models 54ARC/54ABP Dissolved Oxygen Meters, YSI Incorporated, Yellow Springs, Ohio, August, 1988.
2. YSI Product Service (513) 767-7241 or 1-800-343-HELP.

XX. METHOD VALIDATION DATA

Not required, dissolved oxygen measurement used as field screening only.

A/O/MISC/BB7

Standard Operating Procedure for the
Field Measurement of Radioactivity

I. PARAMETERS

Total alpha radiation
Total beta radiation
Total gamma radiation

II. RANGE OF MEASUREMENT

At x 1 range rocker switch: 0-5 mR/h
At x 100 range rocker switch: 0-500 mR/h
or with external probe:
At x 1 range rocker switch: 0-5,000 cpm
At x 100 range rocker switch: 0-500,000 cpm

III. LIMIT OF DETECTION

1 mR/h or 1 cpm at X 1 range
100 mR/h or 100 cpm at x 100 range

IV. SAMPLE MATRIX

Soil collected during the installation of monitoring wells and the land-fill cap investigation will be analyzed.

V. PRINCIPLE, SCOPE, AND APPLICATION

A halogen quenched Geiger - Mueller tube is used as the detector in the Mini CONRAD II. The Mini CONRAD II is intended to be used as a survey instrument by itself and a contamination meter with the external probe. In order to quantitatively assess the radioactivity present in site soils, the external probe accessory will be used to measure total alpha, beta, and gamma contamination in counts per minute (cpm).

VI. INTERFERENCES AND CORRECTIVE ACTION

The operating temperature range is from -12°F to +122°F. Extremely cold weather may result in erroneous readings. Use in a warmer environment and bring sample to the meter rather than using it directly at the sample collection site.

If the speaker or 9-volt battery is oriented so that it is between the detector (probe) and sample to be measured or calibration source, the instrument will not respond with the stated accuracy of 10%. Ensure that the GM tube indicator target mark on the probe is aimed toward the sample or calibration source.

VII. SAFETY PRECAUTIONS

The overflow circuitry insures that the meter will continue to read full-scale in fields up to 100 times the maximum range, giving an indication of high radiation levels so the user can avoid exposure. However, the user should exercise caution in working in any suspected radioactive environment.

The instrument has been drop-tested at heights of up to four feet onto concrete. Caution should still be used in protecting the geiger tube (probe) assembly.

VIII. SAMPLE SIZE, COLLECTION, PRESERVATION, AND HANDLING

Samples will be analyzed in the field directly from the split spoon or sample trowel. No preservation is required.

IX. APPARATUS

Mini CONRAD II Portable Radiological Survey Meter
Meter 3089 Probe

X. ROUTINE PREVENTIVE MAINTENANCE

Semi-annual calibration by the manufacturer, Dosimeter Corporation, is recommended. When the instrument is stored for longer than one week, the 9-volt battery should be removed.

XI. REAGENTS AND CALIBRATION STANDARDS

The target center calibration standards is supplied with the instrument. No shelf life or storage is applicable.

XII. CALIBRATION PROCEDURES

The manufacturer recommends that the Mini CONRAD only be calibrated semi-annually. Determine from the instrument log the last date of calibration and assess if any in-field calibration will be needed. The calibration procedure is as follows:

1. Place the range switch in the low (x1) position.
2. Remove the "x1" plastic screw that covers the low-range calibration control.
3. Turn the Mini CONRAD II on and place the target center in the appropriate field for the instrument being calibrated: Model 3034 3 mR/h.
4. Adjust the "x1" control for the proper indication on the meter scale.
5. Reduce the field by approximately 50 percent. The Mini CONRAD II must indicate with 15 percent of the field value.

6. Replace the "x1" plastic screw.
7. Place the range switch in the high (x100) position, remove the "x100" plastic screw and place the Mini CONRAD II target center in the appropriate field: Model 3034 300 mR/h.
8. Adjust the "x100" control for the proper indication on the meter scale. The field intensity is 100 times the value indicated.
9. Reduce the field by approximately 50 percent. The Mini CONRAD II reading, multiplied by 100, must be within 15 percent of the field.
10. Replace the "x100" plastic screw and turn the Mini CONRAD II Off.

Note:

For calibration purposes, the "target center" is the intersection of the targets on the case.

XIII. SAMPLE PREPARATION

No sample preparation is necessary, probe is to be pointed at sample contained in the split spoon or trowel.

XIV. ANALYTICAL MEASUREMENT

1. Check the battery by putting the power switch in the BATT (left) position. The switch must be held in this position since it is spring-loaded and will return to the OFF position when released.
2. The meter should indicate a reading in the BATT range. If the reading is below, the battery should be replaced as less than 8 hours of battery life remain.
3. Press the power switch to ON (right) position.
4. Plug in the probe and point the probe at the sample (within 2-3 inches).
5. Select the desired range x1 or x100 with the range switch. Read the cpm scale. For most sites/samples, the x1 range is most applicable.
6. If the x100 range is used, be sure to multiply the cpm reading by 100.
7. Record the cpm on the Soils Data Form.

XV. FLOW CHART

Not applicable.

XVI. DATA TREATMENT

Instrument is direct readout unless x100 range is used. If x100 range is used, multiply readings by 100.

XVII. DATA DELIVERABLES

Not applicable. Record reading on Soils Data Form.

XVIII. QUALITY CONTROL REQUIREMENTS

One soil sample for every ten measured should be split into two aliquots and have a reading taken on each. Both measurements should be recorded on the Soils Data Form, and the rpd calculated. It is expected that readings will agree to within 15%.

An off-site background soil will be measured daily to determine background counts.

XIV. REFERENCES

Instruction Manual, Mini CONRAD II Portable Survey Meter

Dosimeter Corporation (513) 489-8100

XX. METHOD VALIDATION DATA

Radioactivity is being measured for field screening and health and safety purposes, so method validation data is not required.

A/O/MISC/BB9

Standard Operating Procedure for the
Field Measurement of Methane and Hydrogen Sulfide

I. PARAMETERS

Methane (CH₄), as % LEL
Hydrogen sulfide (H₂S), as ppm

II. RANGE OF MEASUREMENT

CH₄ 0-100% LEL
H₂S 0-100 ppm

III. LIMIT OF DETECTION

CH₄ 1% LEL
H₂S 1 ppm

IV. SAMPLE MATRIX

Gases, vapors, ambient air.

V. PRINCIPLE, SCOPE, AND APPLICATION

A catalytic sensor provides a linear output to the meter circuit to read the presence of combustible gas. As the instrument is factory-calibrated to methane, the reading is equated with % LEL as methane. An electrochemical reaction sensor provides measurement of H₂S.

VI. INTERFERENCES AND CORRECTIVE ACTION

Water drawn through the sampling pump will contaminate the pump and sensors. Attach a water trap and filter device as a preventive measure. If water is sucked into the pump, open the instrument and dry it quickly with a warm air drier as soon as possible. The unit must then be sent in for service.

VII. SAFETY PRECAUTIONS

The Gasponder IV is designed to be intrinsically safe for operation in confined spaces with potentially hazardous atmosphere. However, no instrument can completely guarantee that the atmosphere is free of contamination simply because no readings are obtained.

The instrument itself should only be charged with its own AC charger. No substitutions should be made. The calibration gas cylinders should be handled carefully in accordance with good laboratory practices.

VIII. SAMPLE SIZE, COLLECTION, PRESERVATION, AND HANDLING

The Gasponder IV sample intake tubing will be placed in the soil gas probe or near suspected entry locations for CH₄/H₂S in residential basements, and the CH₄ and H₂S readings taken immediately.

IX. APPARATUS AND MATERIALS

Gasponder IV PGM-14
Tygon tubing
Battery pack and spare
Thermal-protected charger
Water trap and filter device
Methane/CO calibration cylinder
H₂S calibration cylinder
Gas regulator and hose

X. ROUTINE PREVENTIVE MAINTENANCE

Only trained and authorized Lumidor personnel should attempt any maintenance or repairs other than calibration and replacement of the battery pack.

Calibration is discussed in Section 12. Battery pack replacement should be done when the digital meter face indicates LO-BAT.

XI. REAGENTS AND CALIBRATION STANDARDS

Two calibration gas cylinders are supplied with the instrument:

CH₄/CO (50% LEL and 250 ppm CO)
H₂S (25 ppm)

New cylinders should be reordered from Lumidor when the regulator indicates that the cylinder is near empty.

XII. CALIBRATION PROCEDURES

1. Initial start-up and zero set

- a. Place selector at any "ON" position. All alarm lights should be "ON." Alarm horn should activate for several seconds, and display will indicate 1.888.
- b. Turn selector switch to "BATT. TEST." Reading should be 4.9V minimum.
- c. If less than 4.9V, place on charge for several hours.
- d. Attach sampling hose and pinch tightly. "LOW FLOW" alarm should indicate and horn should sound.

- e. Instrument should be run at least 15 minutes.
- f. Place selector on "BATT. TEST" - check reading.
- g. Place selector on H₂S and set "ZERO."

2. Calibration

- a. Locate opening provided at side of main case to gain access to calibration adjustment for H₂S and CH₄.
- b. Attach flow regulator on Methane/CO cylinder.
- c. With selector set to "CH₄," check "ZERO" setting. If necessary, readjust with panel adjustment only.
- d. Repeat step 2 for "H₂S."
- e. Return selector switch to the "CH₄" position. Turn on flow regulator, and connect hose to unit using quick disconnect fitting.
- f. After one minute, adjust calibration screw until reading is the same as stated on cylinder label. (i.e. 50% LEL).
- g. Turn off flow regulator and remove regulator from cylinder.
- h. Attach flow regulator to cylinder marked H₂S (RED).
- i. Turn selector switch to the H₂S position. Turn on flow regulator and connect hose to unit using quick disconnect fitting. After three minutes, adjust calibration screw until reading is the same as stated on cylinder (i.e. 225 ppm). Disregard "O₂" alarm that occurs during this test.
- j. When calibration procedure is completed, remove the gas regulator from cylinder, carefully repack all components, and replace calibration cover securely.

XIII. SAMPLE PREPARATION

Not applicable, analysis is done directly on waste mass gas in sampling probe or residential air.

XIV. ANALYTICAL MEASUREMENT

- 1. Attach sampling hose to gas inlet and lower into probe. Do not allow hose to contact any water or leachate. In residential basements, place hose near cracks in foundation or sump pump areas.
- 2. Switch dial to "Read ppm H₂S." Record on Soils Data Form.

3. Switch dial to "Read % LEL Methane." Record on Soils Data Form.
4. Remove hose from probe or sampling area, and proceed to next sampling location.

XV. FLOW CHART

Not applicable.

XVI. DATA TREATMENT

Not applicable. Record results of calibration on Field Meter Instrument Calibration Log and results on Soils Data Form.

XVIII. QUALITY CONTROL

Not applicable as measurements are real time direct read-outs. An upwind off-site location will be measured daily before field work to determine background conditions.

IX. REFERENCES

1. Lumidor Safety Products Operating Instructions for Gasponder IV Model PGM-14, May, 1987, Revision I.
2. Lumidor Product Service (305) 625-6511.

XX. METHOD VALIDATION DATA

Not applicable as CH₄ and H₂S are being measured for field screening to select sampling locations.

A/O/MISC/BB7

APPENDIX F

DETERMINATION OF NUMBER OF SAMPLES OF
CAP SOIL FOR CHEMICAL ANALYSIS

DETERMINATION OF # SAMPLES OF CAP SOIL FOR CHEMICAL ANALYSIS

Reference: SOIL SAMPLING QUALITY ASSURANCE USERS GUIDE (TABLE 4)
EPA/600/8-89-046

Assumptions:

o) purpose of samples to assess if any contamination above risk based levels
1) for Coefficient of Variation (CV)
use CLP Level IV data in soil in Appendix F EPA/540/G-87/003

a) Volatiles: 13.8% CV use Table value of 15%.
Key analytes detected in Hmco historical groundwater data (acetone, 2-butanone, trans-1,2-dichloroethene) do not have CV as % rsd data available, used toluene which was detected in one sample

b) Semivolatiles: 32% CV (\bar{x}) use Table value of 30%
used key analytes of pyrene + phenol,
mean = 32%. (26%) (38%)

c) Metals: 14% CV (\bar{x}) use Table value of 15%
used key analytes of arsenic, chromium, lead + mercury detected at levels above MCL in groundwater:
As: NA Pb: 9.2%
Cr: 7.8% Hg: 25%

2) for minimum detectable difference, use CLP Lab duplicate (metals) or MS/MSD relative percent difference mean limits:
table 4 value used

Metals:	20%	20%
Volatiles:	$\bar{x} = 21.8$ $n = 5$	20%
Semivolatiles:	$\bar{x} = 36.8$ $n = 11$	40%

FROM TABLE 4 - 95% Power } 12 SAMPLES
99% Confidence

TABLE 4. NUMBER OF SAMPLES REQUIRED IN A ONE-SIDED ONE-SAMPLE t-TEST TO ACHIEVE A MINIMUM DETECTABLE RELATIVE DIFFERENCE AT CONFIDENCE LEVEL (1- α) AND POWER OF (1- β).

Coefficient of Variation (%)	Power (%)	Confidence Level (%)	Minimum Detectable Relative Difference (%)				
			5	10	20	30	40
10	95	99	66	19	7	5	4
		95	45	13	5	3	3
		90	36	10	3	2	2
		80	26	7	2	2	1
	90	99	55	16	6	5	4
		95	36	10	4	3	2
		90	28	8	3	2	2
		80	19	5	2	1	1
	80	99	43	13	6	4	4
		95	27	8	3	3	2
		90	19	6	2	2	2
		80	12	4	2	1	1
15	95	99	145	39	12 X	7	5
		95	99	26	8	5	3
		90	78	21	6	3	3
		80	57	15	4	2	2
	90	99	120	32	11	6	5
		95	79	21	7	4	3
		90	60	16	5	3	2
		80	41	11	3	2	1
	80	99	94	26	9	6	5
		95	58	16	5	3	3
		90	42	11	4	2	2
		80	26	7	2	2	1
20	95	99	256	66	19	10	7
		95	175	45	13	9	5
		90	138	36	10	5	3
		80	100	26	7	4	2
	90	99	211	55	16	9	6
		95	139	36	10	6	4
		90	107	28	8	4	3
		80	73	19	5	3	2
	80	99	164	43	13	8	6
		95	101	27	8	5	3
		90	73	19	6	3	2
		80	46	12	4	2	2

VSA
metals

TABLE 4. CONTINUED

Coefficient of Variation (%)	Power (%)	Confidence Level (%)	Minimum Detectable Relative Difference (%)				
			5	10	20	30	40
25	95	99	397	102	28	14	9
		95	272	69	19	9	6
		90	216	55	15	7	5
		80	155	40	11	5	3
	90	99	329	85	24	12	8
		95	272	70	19	9	6
		90	166	42	12	6	4
		80	114	29	8	4	3
	80	99	254	66	19	10	7
		95	156	41	12	6	4
		90	114	30	8	4	3
		80	72	19	5	3	2
30	95	99	571	145	39	19	12
		95	391	99	26	13	8
		90	310	78	21	10	6
		80	223	57	15	7	4
	90	99	472	120	32	16	11
		95	310	79	21	10	7
		90	238	61	16	8	5
		80	163	41	11	5	3
	80	99	364	84	26	13	9
		95	224	58	16	8	5
		90	164	42	11	6	4
		80	103	26	7	4	2
35	95	99	775	196	42	25	15
		95	532	134	35	17	10
		90	421	106	28	13	8
		80	304	77	20	9	6
	90	99	641	163	43	21	13
		95	421	107	28	14	8
		90	323	82	21	10	6
		80	222	56	15	7	4
	80	99	495	126	34	17	11
		95	305	78	21	10	7
		90	222	57	15	7	5
		80	140	36	10	5	3

Semi-10AS

APPENDIX G

DETERMINATION OF NUMBER OF SAMPLES OF
MONITORING WELL BORINGS FOR CHEMICAL ANALYSIS

DETERMINATION OF NUMBER OF SAMPLES OF SOIL FROM
MONITORING WELL BORINGS FOR CHEMICAL ANALYSIS - HIMCO

Reference: Soil Sampling Quality Assurance Users Guide
Table 4
EPA/600/8-89-046

Assumptions:

1. Purpose to determine if contamination present.
2. For CV use CLP Level IV data in soil in Appendix F EPA/540/G-87/003
3. Use E&E sediment data for key analytes:

Relative Standard Deviation for the following analytes:

diethylpntthalate (33)	As (NA) Al (14)	
(used bis (2-ethylhexyl) phthalate	Pb (9) Cr (8)	
Acetone (NA)	Ni (15)	X metals = (12)
CH ₂ Cl ₂ (NA)		use 30
	Lab Blank	

4. For maximum detectable difference used CLP lab duplicate (metals) or matrix spike/matrix spike duplicate relative percent difference limits.

mean limits: Metals 20%
 VOAs 20%
 Semi VOA 40%

From Table 4 - 99% CI, 95% power

Metals	n - 7
VOAs	n = 14
Semi VOA	<u>n = 10</u>
	X = 10.3 use 30

Total possible number samples: 6 wells at 175' = 35 x 6 = 210
1 well at 20' = 4 x 1 = 4
3 wells at 150' = 3 x 30 = 90
304

ARCS/P/HIMCO/AC5